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ABSTRACT

This volume is the tenth in a series of 29 coordinated MINNEMAST units in mathematics and science for kindergarten and the primary grades. Intended for use by first-grade teachers, this unit guide provides a summary and overview of the unit, a list of materials needed, and descriptions of two groups of activities. The purposes and procedures for each activity are discussed. Examples of questions and discussion topics are given, and in several cases ditto masters, stories for reading aloud, and other instructional materials are included in the book. This volume introduces the basic geometric notion of linearity, and provides activities related to the use of properties of lines in determining positions of objects. Lessons are organized into two sections: (1) lines, direction and location, and (2) locations and maps. A master for a "take-home fun activity" related to location of places on a map is also included. (SD)

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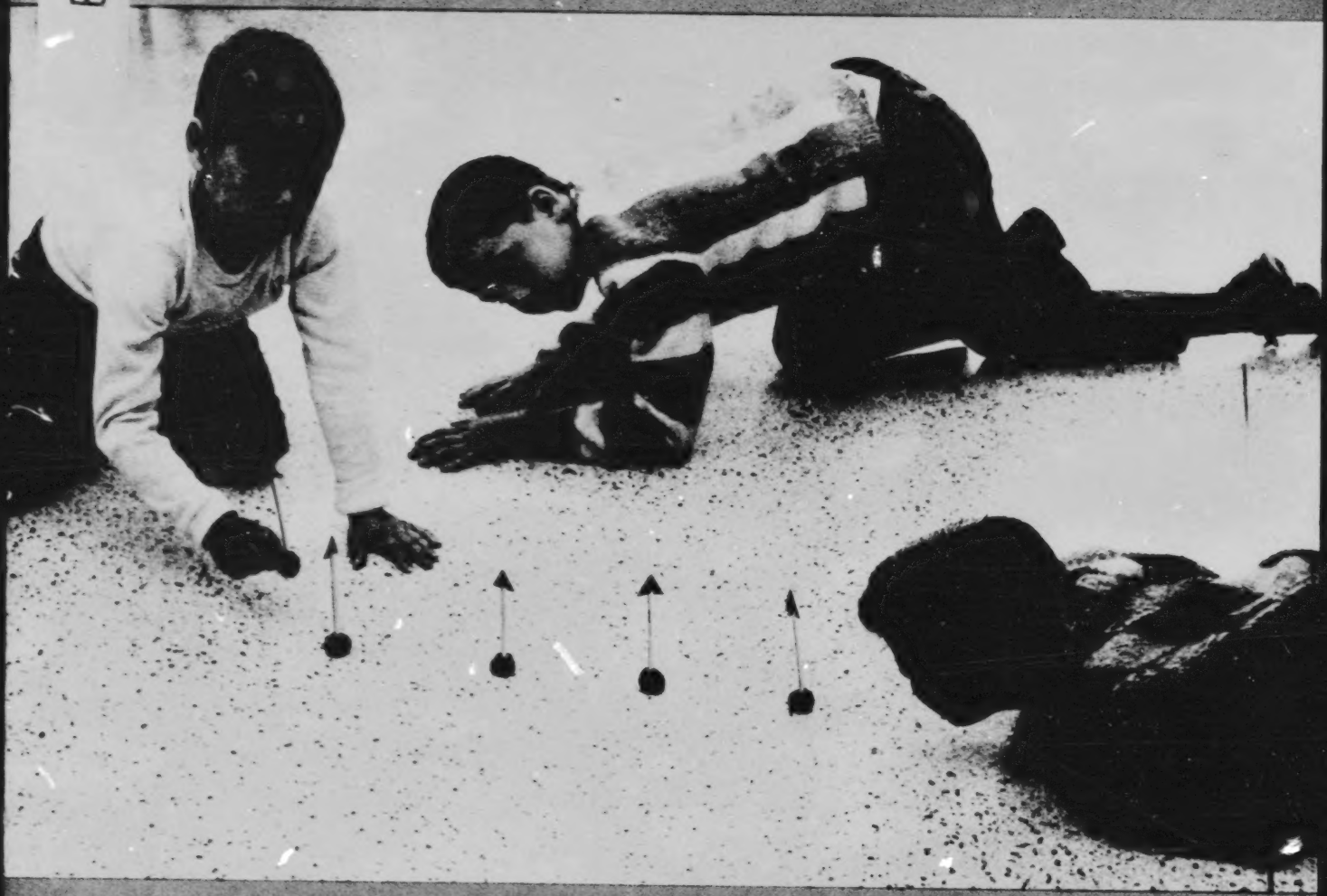

UNIT 10

MINNESOTA MATHEMATICS AND SCIENCE TEACHING PROJECT

2

SE 021 215

MINNEMAST COORDINATED MATHEMATICS–SCIENCE SERIES

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	2.	CURVES AND SHAPES
	3.	DESCRIBING AND CLASSIFYING
	4.	USING OUR SENSES
	5.	INTRODUCING MEASUREMENT
	6.	NUMERATION
FIRST GRADE	7.	INTRODUCING SYMMETRY
	8.	OBSERVING PROPERTIES
	9.	NUMBERS AND COUNTING
	● 10.	DESCRIBING LOCATIONS
	11.	INTRODUCING ADDITION AND SUBTRACTION
	12.	MEASUREMENT WITH REFERENCE UNITS
	13.	INTERPRETATIONS OF ADDITION AND SUBTRACTION
SECOND GRADE	14.	EXPLORING SYMMETRICAL PATTERNS
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	17.	INTRODUCING MULTIPLICATION AND DIVISION
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	19.	COMPARING CHANGES
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THIRD GRADE	22.	PARTS AND PIECES
	23.	CONDITIONS AFFECTING LIFE
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Third Printing, 1971

DESCRIBING LOCATIONS

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on the basis of the experience
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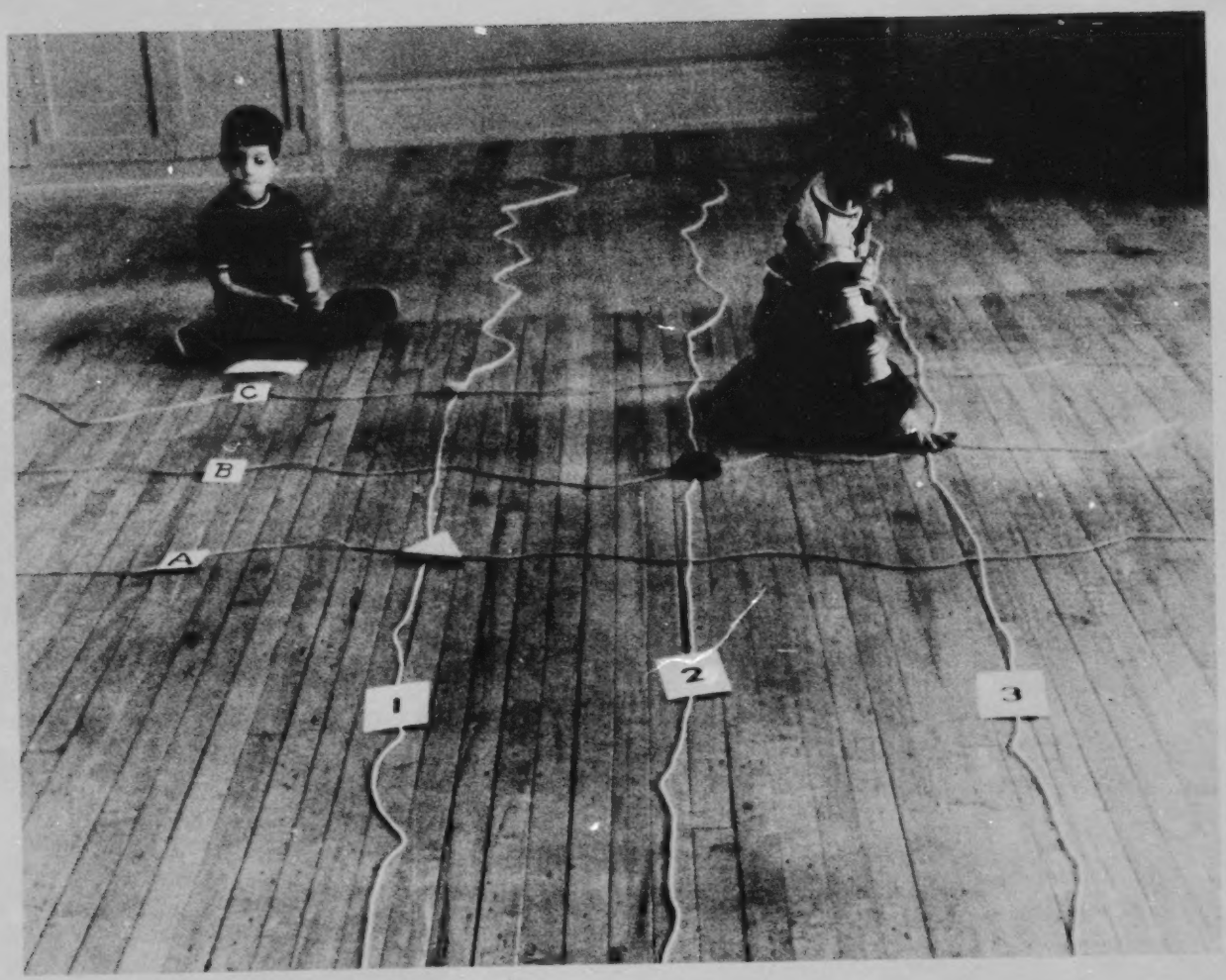

In their first experiences with grids, the children learn to locate intersections by placing blocks at points specified by the teacher (Lesson 10).

CONTENTS

Materials List for Unit		vi
Suggested Teaching Schedule for MINNEMAST First Grade Units		viii
Introduction		1
Section 1: Lines, Direction and Location		3
Lesson 1	Describing Locations	4
Lesson 2	Points and Line Segments	7
Lesson 3	Lines and Line Segments	13
Lesson 4	Lines Determined by Three Points	18
Lesson 5	Sighting Along Lines of Objects	21
Lesson 6	Locations on Lines (Two Reference Points)	33
Lesson 7	Locations on Lines (Three Reference Points)	40
Lesson 8	Reading the Treasure Map	43
Section 2: Locations and Maps		54
Lesson 9	Intersections and Unions	55
Lesson 10	Intersection Points on a Grid	62
Lesson 11	Locations Between Parallel Lines	68
Lesson 12	"Where Has Sally Been?"	76
Lesson 13	A Simple Map of the Classroom	83
Lesson 14	A Map of the Neighborhood	86
Review Note		87
Take-Home Fun Sheet		88
Sally Cutouts		89

Complete List of Materials for Unit 10

(Numbers based on class size of 30.)

total number required to teach unit	item	lessons in which item is used
2-5	sets of four objects that look exactly alike	1
10	large cards, numbered 1-10	1
1	* meter stick	2
200	* map tacks	2
3-5	pieces of chalk of varied colors	2,6,7
30	pencils	2,3,4,7,8
30	* rulers	2,3,4,7,8
30	boxes of crayons	2,4,5,7, 11
6	* balls of yarn (2 of same color)	2,3,6,9, 10,11,14
4	cords, 5" x 9"	3,6
50-70	* soda straws	5
1	razor blade or scissors	5
50-70	small triangles of orange paper	5
50-70	* small lumps of clay	5
1	* roll of masking tape	6,10,13
1	transparency [illegible] made from Worksheet 23	8
1	grease pencil	8
1	overhead projector	8,11,12
1	*** set of property blocks	9,10,11,13
12	red and blue blocks (cover red property blocks with blue paper or vice versa)	9
12	cards, labeled 1-6, A-F	10

	Sally cut-outs, page 89 of this manual	12
1	transparency of Worksheet 34 (optional)	12
1	felt-tip marking pen	13
1	4' x 4' piece of wrapping paper or newsprint	13
31	name cards	13
1	3' x 4' piece of wrapping paper or newsprint	14
5-10	sheets of construction paper, scissors and paste	14

*kit items as well as

**printed materials available from
Minnemath Center, 720 Washington Ave. S.E., Mpls., Minn. 55455

***available from The Judy Company,
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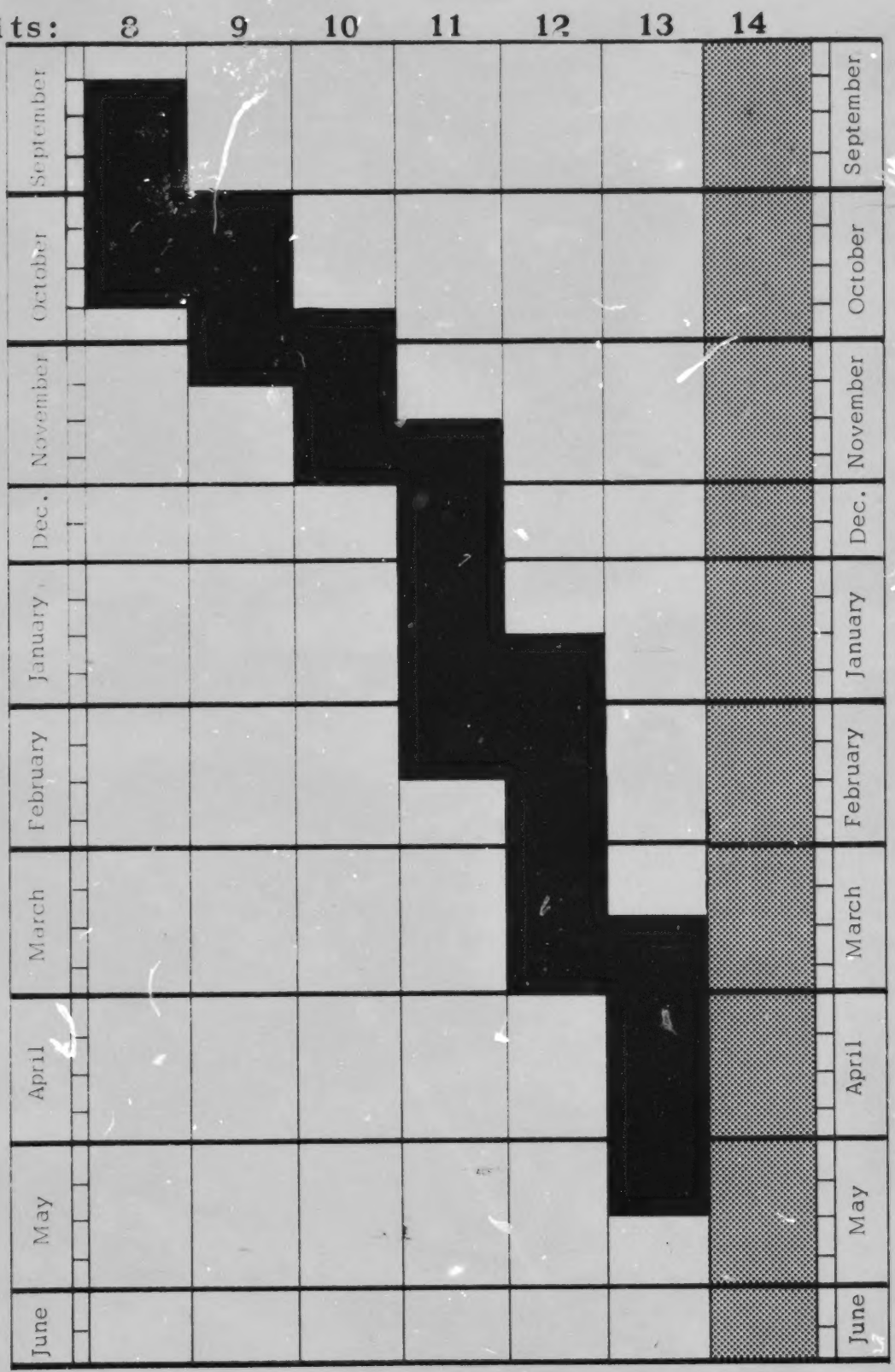
Suggested Teaching Schedule for MINNEMAST First Grade Units



INTRODUCTION

Geometry can be treated in a completely abstract or completely concrete fashion. A fully concrete approach would focus mainly on measuring and constructing lines and figures, using rulers, compasses, protractors and other tools. A fully abstract approach would consider only logical relations among terms that do not necessarily have spatial or physical meaning. The approach in this unit is somewhere between these two extremes.

Two concepts provide the unifying themes for this unit. These are (1) the concept of describing a location by using a frame of reference, and (2) the concept of location as a point or set of points. Both relate to the ways in which we can describe the location of an object.

A reference frame is some particular arrangement of objects, in relation to which we describe some other object's position or location. Whatever reference objects we mention, in describing a location, form the reference frame we happen to be using. Reference objects and frames need not be physical objects -- points and lines may be used. We can describe the location of a single object in many different ways by using different frames of reference.

Sometimes we describe the location of an object in general terms. We use terms of spacial relations, such as on, under, between, etc. These describe larger sets of points than the objects actually occupy, but do give us general locations.

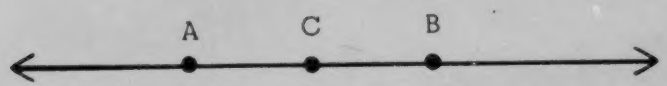
We can also give a more exact location description that tells which points an object does and does not occupy in space. Such an exact description might be "at the intersection of line AB and line CD" or "ten feet due north of the flagpole."

NOTES ON TEACHING THE UNIT

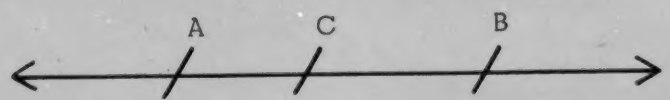
This unit is intended to be an introduction to the ideas of a point, line segment, line, etc. No special emphasis should be placed at this time on using the exact terminology. As an example, a line designated by the two points, A and B, may be referred to as "the line AB." The shortcut notation is $\overleftrightarrow{AB}$.

Both types of notation are used in the unit and it is hoped that the children will become familiar with the notation without use of drill work.

It is strongly recommended that when you are locating points on a line or line segment, you use a dot rather than a slash. For example: To indicate point C on line AB (between points A and B), locate the point like this:



not like this:



You may wish to provide extra time for your class to practice drawing lines and line segments with a pencil and ruler. Give them as much practice as they need.

The lessons are divided by subject matter, rather than by the length of time required for teaching them.

SECTION 1 LINES, DIRECTION AND LOCATION

PURPOSE

- To introduce the notion of a point, a line segment and a line.
- To present ways of describing lines and directions along lines in terms of reference objects (points on the line).
- To introduce the representation of an object's location by line, point and frame of reference.

COMMENTARY

Lesson 1 focuses on the fact that objects have positions or locations that can be described in relation to other objects in the classroom. Lessons 2, 3 and 4 introduce the ideas of a point, a line segment and a line. In this unit "line" always means "a straight line." A line segment is only a part of a line; a line is endless. Concrete objects such as yarn and string are used to help the children understand the concept of a line and the idea that a line extends beyond the ends of a line segment. We develop the concept that a line and a line segment are made up of a set of points. Lesson 5 helps children to visualize lines determined by several reference objects, when no actual representations of lines, such as string or drawings, are present. It reinforces the idea that lines extend beyond line segments. Lessons 6 and 7 give the children the opportunity to describe the direction of the motion of an object along a line as well as the location of the object. Lesson 8 aims at introducing the use of points and lines drawn on maps as a way of representing objects and their locations in the physical world. This preliminary map activity will be expanded in Section 2, where the children will learn more ways of representing locations of objects.

Lesson 1: DESCRIBING LOCATIONS

In this lesson, the children are shown a set of four apparently identical objects. The only way in which the objects differ is in their positions. The children are asked to identify each object, which they can only do by describing its location.

You will find that the children give location descriptions in terms of simple reference frames. For example, they will say an object is located on, next to or under other objects. Your room and the objects in it will be the children's reference frame for this lesson.

To develop appropriate vocabulary, introduce casually the words "reference objects," "location -- the place where it is" and "location description." Use these words as often as possible throughout the lesson, but don't insist that the children use them until they begin to do so naturally.

MATERIALS

- several sets of four objects that look exactly alike (Examples: set of four identical books, set of four identical blocks, set of four identical Minnebars). Objects should be large enough to be seen easily. Each set should have members that are entirely different from the members of any other set.
- large cards numbered from 1 to 10

PROCEDURE

Activity A

Let your class watch while you distribute the members of one set of objects (e.g., four identical green books) around the room in conspicuous places. The objects, which look exactly alike, should not be put too near each other. Mention that these objects are part of a game set. Say:

> I'M THINKING OF A GREEN OBJECT FROM MY GAME SET. WHO CAN TELL ME WHICH OBJECT I'M THINKING OF? (The children should have no difficulty in saying that you're thinking of a green book.)

BUT THERE ARE FOUR OF THEM. WHICH ONE AM I THINKING OF?

You may wish to let the children see you look at the book about which you are thinking. At first, allow the children to point. After they have pointed at the book you selected, tell them that from now on, pointing is not allowed. They must use words to tell you the object of which you are thinking. They must tell you where it is located. You may wish to continue using the same four objects or to use a new set.

This is an example of how the game might go, if you were using a set of red books:

I'M THINKING OF A RED OBJECT FROM MY SET. WHAT AM I THINKING OF? (A red book.)

YES. WHICH ONE? (Is it the book on your desk?)

NO, IT'S NOT THE BOOK LOCATED ON MY DESK. MY DESK IS NOT THE REFERENCE OBJECT NEAREST TO IT. (Is it on the chalkboard tray?)

YES, THE CHALKBOARD TRAY IS THE REFERENCE OBJECT NEAREST TO IT. IT IS LOCATED ON THE TRAY. BUT THERE ARE TWO RED BOOKS LOCATED THERE. WHICH ONE AM I THINKING OF? (Is it the one between the two erasers?)

NO. (It's the other one.)

YES, CAN YOU DESCRIBE ITS LOCATION FOR ME? TELL ME WHERE IT IS IN WORDS. (On the chalkboard tray, not between the two erasers.)

THAT IS A GOOD LOCATION DESCRIPTION.

You may need to help the children at first by giving them some verbal answers, using words such as "between," "on," etc. This will depend on the ability of your class.

After several rounds have been played, the children may take turns being "It." "It" chooses an object in the room, whispers

to you what it is, and then gives the class a location description from which they identify the object he has chosen. When he whispers to you the name of the object he must be careful not to point, because that would spoil the game. Encourage the children to use as many different spatial relation words as they seem familiar with: in, on, under, above, below, behind, in front of, next to, beside, between, near, right, left, etc. Encourage them to describe locations by mentioning reference objects. A child himself can be a reference object if he says, "In front of me."

Activity B

Put ten large numeral cards in distinctly different locations about the room. A child picks a numeral from 1 to 10. He whispers it to you. Then he must describe to the class the location of that card, so another child can find the card with the chosen numeral. "It" must not mention the numeral or point to the card, but the others can ask him questions about the card's location. If the children seem to be eliminating numbers from the set 1 - 10, rather than focusing on locations, use 10 cards with random numbers (such as 2, 4, 7, 12, 19, 20, 21, 24, 27, 29).

Optional Activities

1. One child picks an object in the classroom and keeps his selection secret. He describes the location of the object he has chosen, and others try to identify the object. The first child may not point, mention the kind of object, or describe it in any way except by its location. Others may ask him questions to get a better description of the location. The questions must be about locations (e.g., "Is the object in front of the teacher's desk? ").

2. A sit-down version of hide-the-thimble gives the children practice at describing locations. "It" hides the thimble or other object. The other children search for it verbally by asking location questions. "It" answers with "hot," "cold," "getting warmer," etc.

Lesson 2: POINTS AND LINE SEGMENTS

This lesson introduces the idea of a point. Emphasis is placed on the idea that a point is useful as a location description. Then, beginning with two points, a set of points (a line segment) is generated between them. Practice is provided for drawing line segments. The notation for line segment should be introduced casually. You may write "line segment AB" and "$\overline{AB}$" alternately until you are sure the children are completely comfortable with the shorter form. ($\overline{AB}$ is read "line segment AB.")

MATERIALS

— meterstick

— about 200 map tacks

— piece of red chalk

-- for each child --

— pencil

— ruler

— red, yellow, blue and green crayons

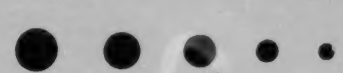
— 12-inch length of yarn

— Worksheets 1, 2, 3 and 4 in Student Manuals

PROCEDURE

Activity A

On the chalkboard, draw pictures of several different geometric shapes. (You may wish to trace a square, rectangle, circle, triangle, etc.) Then let the children identify them. After the shapes have been properly identified, draw a dot (point) on the chalkboard. Ask the children to describe this geometric figure. Some may call it a dot or a circle. Explain to the children that mathematicians say that a dot represents a point (a dot is a picture of a point). Draw several dots of various sizes on the chalkboard.



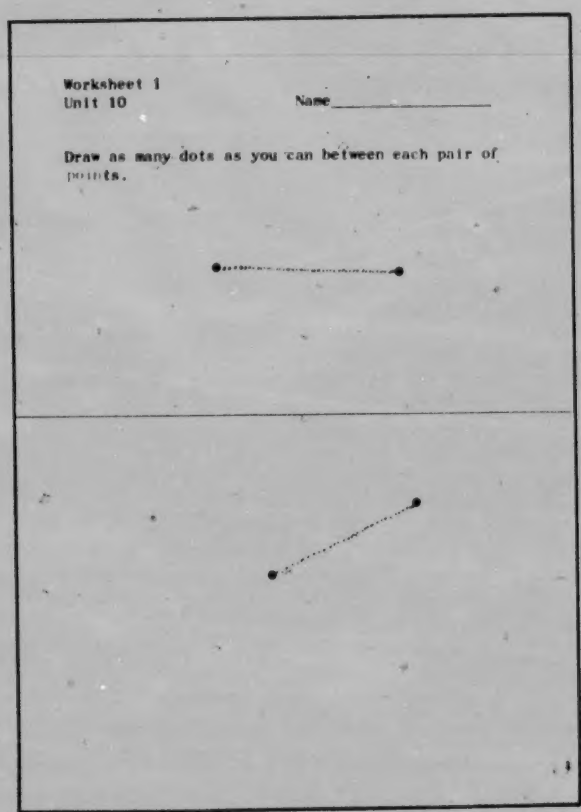
Ask:

WHICH OF THESE DOTS BEST REPRESENTS THE LOCATION OF A POINT? (The smallest dot.)

Briefly mention to the children that the smaller the picture of the point, the better the representation. Have different children come up to the chalkboard to practice drawing pictures of points. The others may practice at their desks until you are satisfied that your class can draw reasonably small representations of points.

Activity B

Draw two dots about 12 inches apart on the chalkboard, low enough so the children can reach them. Ask one of your students to draw as many dots to represent points as he can and to place them directly between these two points. You may wish to have several children do this, each with a different pair of points. Try to get the children to draw smaller and smaller dots until their diagrams look something like this:


Worksheet 1
Unit 10 Name_____

Draw as many dots as you can between each pair of points.

8

Encourage the children to add more dots by asking if they could insert still another dot wherever a space is visible. If there is a large dot, they might erase it and replace it with smaller ones. You may need to help them with this activity.

Have the children turn to Worksheet 1 in their Student Manuals. Read the instructions to them. After they have completed their worksheets, they should compare their work with that on the chalkboard to see if they have drawn as many dots as possible

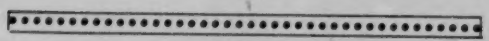
between the two given dots. They should finally have drawn enough dots between the original two so that the diagrams resemble a line segment. Discuss the new geometric figure they now have on the worksheet.

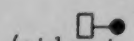
WHAT DOES YOUR SET OF DOTS LOOK LIKE?

Some of the children may call this a line. Explain that each diagram is only part of a line and is called a line segment. Remind the children that the dots represent points. Then say:

A LINE SEGMENT IS MADE UP OF A SET OF POINTS.

In order to help the children understand the idea that a line segment is made up of a set of points, you could stick about 200 map tacks, about one-half cm apart, on a meter stick.

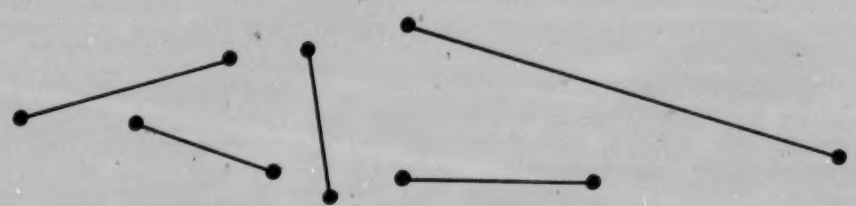




Hold the stick parallel to the floor in front of the children and turn it until they can see that the heads of the map tacks resemble a solid line segment.

Activity C

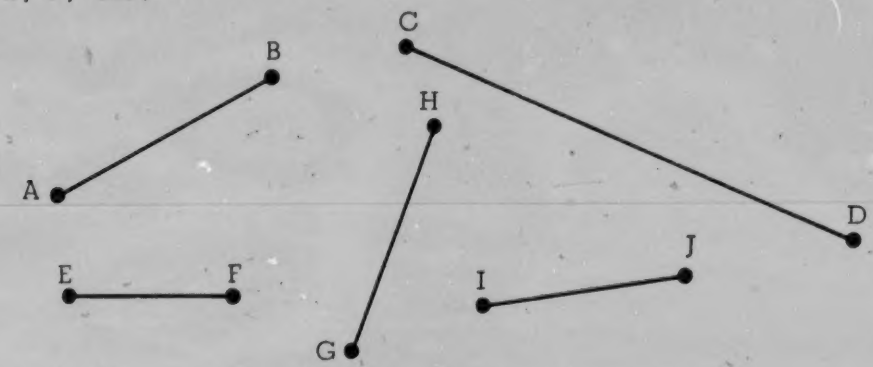
Draw several line segments on your chalkboard. Draw them as follows (●——●). The end points should be overemphasized so that they may better serve to help locate and identify line segments. Your line segments may look like these:



Conduct a discussion about these line segments, using questions such as:

> HOW MANY LINE SEGMENTS DO WE HAVE? (Five.) DO THEY ALL CONTAIN THE SAME SET OF POINTS? (No.) ARE THEY ALL LOCATED IN THE SAME POSITION? (No.) I AM THINKING OF ONE OF THE LINE SEGMENTS. WHICH LINE SEGMENT AM I THINKING OF? (The children may guess by pointing or by using location expressions such as "at the top," at the bottom," "at the far left," etc.)

Continue by explaining that they will need some method of identifying or labeling the line segments in order to determine very quickly the location of whichever line segment they are discussing. Say that letters of the alphabet can be used to name the end points of each line segment. Then label the end points of the chalkboard line segments A, B; C, D; E, F; etc.



Mentally select one line segment, such as CD and say:

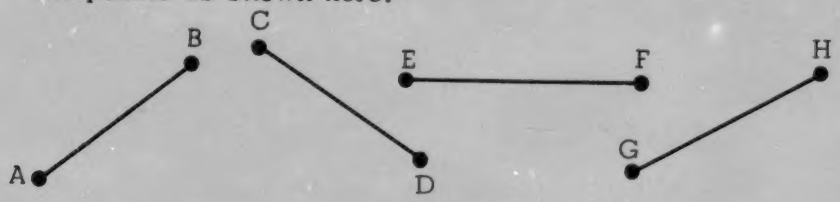
> I AM THINKING OF A LINE SEGMENT. WHICH LINE SEGMENT AM I THINKING OF? (The children will locate it by guessing the letters.)

Ask a child to locate line segment GH, line segment AB, etc. Speak of the end points as reference points: "Line segment AB is the segment between the reference points A and B, including these end points." Remember to explain that the dot representing the end points of each line segment is

enlarged only for the purpose of helping to locate and name the segment. Discuss briefly the form of notation "$\overline{AB}$."

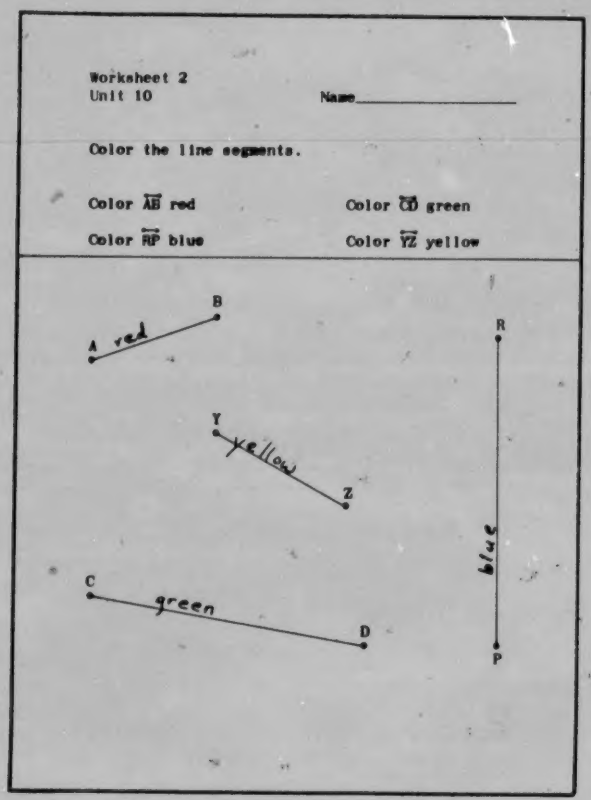
Activity D

Draw several line segments on your chalkboard. Label the end points as shown here:



Explain that the class will play a game of "locating points." Say:

I'M THE SET OF POINTS THAT MAKE UP LINE SEGMENT AB. WHO CAN FIND ME AND COLOR ME RED?


Worksheet 2
Unit 10

Name_____

Color the line segments.

Color $\overline{AB}$ red

Color $\overline{CD}$ green

Color $\overline{RP}$ blue

Color $\overline{YZ}$ yellow

Let one of the children come up to the chalkboard and give him a piece of red chalk so that he can color line segment AB red. Repeat this procedure for the rest of the line segments.

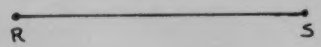
Have the children complete Worksheets 2, 3 and 4. Give them as much help as you feel necessary. You may need to instruct the children in how to use a pencil with a ruler in order to draw straight lines.

11

Worksheet 3
Unit 10 Name_____

Draw a line segment. Label its end points P and Q.

Draw another line segment. Label its end points R and S.



Draw another line segment. Label its end points T and U.

Worksheet 4
Unit 10 Name_____

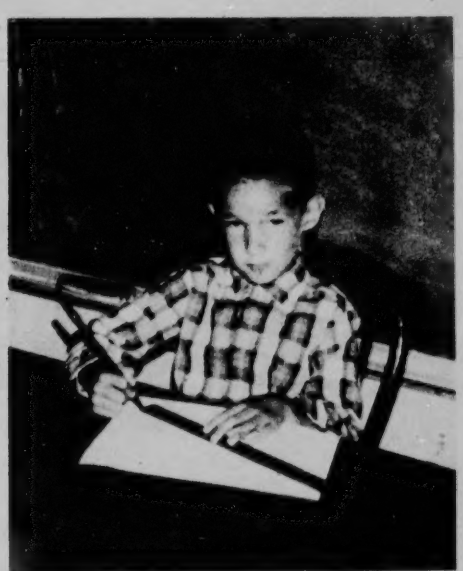
Use your ruler and pencil. Draw line segments connecting pairs of points.

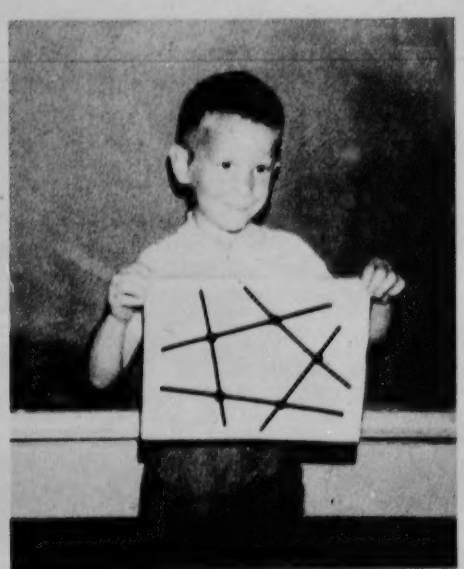
Draw $\overleftrightarrow{AB}$

Draw $\overleftrightarrow{CD}$

Draw $\overleftrightarrow{EF}$

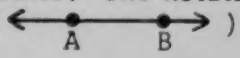
Draw $\overleftrightarrow{GH}$





Ruler held steady near the center, fingers out of the way, pencil drawn firmly along the edge. Result: neat line segments.

Lesson 3: LINES AND LINE SEGMENTS

In this lesson, a line segment is extended from its end points in both directions away from the segment, to help establish the idea that a line is an endless set of points. The lesson will also provide needed practice in drawing representations of line segments between two points and drawing representations of lines named by two points. The notation for a line will be $\overleftrightarrow{AB}$, read "line AB." ()

MATERIALS

- 2 balls of yarn (same color)
- 2 label cards, approximately 5" x 9", one labeled "A," the other "B"
- pencils
- rulers
- Worksheets 5, 6, 7, 8, 9 and 10

PROCEDURE

Activity A

Select two children and place them at the front of the room about ten feet apart. Call one child A and the other B. You may wish to attach yarn to the labeled cards so that they can be hung around the children's necks. Give A two balls of yarn with the ends tied together. Tell your class that A and B are going to be reference objects. Mark the location of A and B on the floor with two large chalk dots. Have Child B go over to A and take one of the balls of yarn, and then walk back to point B, unrolling the yarn as he goes. A continues to hold the other ball. The unrolled yarn should be stretched taut and placed on the floor from point A to point B. Have A and B stand on the yarn. Ask:

WHAT KIND OF FIGURE IS REPRESENTED BY THE YARN BETWEEN THE FEET OF A AND B? (A line segment.)

Ask a third child, say Billy, to take the second ball from A and walk away from A in the opposite direction from B. Be certain to have him walk in a direction that keeps the line straight. When he reaches an obstacle such as the wall, have him stop and stand on the yarn to keep it stretched.

Pose this question to the children:

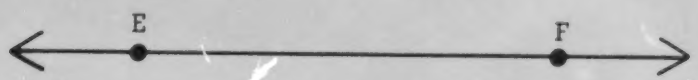
> IMAGINE THAT OUR BALL OF YARN IS VERY LONG. PRETEND THAT BILLY IS MAGIC AND CAN WALK THROUGH THE WALL AND KEEP ON WALKING THROUGH THE CITY, THEN INTO THE NEXT STATE, ETC. HOW FAR COULD HE GO? (On forever.)

Have a fourth child take the yarn from B and walk in the opposite direction from A until he meets an obstacle. Ask the same question. Bring out the idea that this yarn that represents a set of points and passes through A and B and goes on forever in both directions away from A and B, is called a line. Draw the line on the chalkboard:

Let the children make a comparison of the chalkboard diagram and the yarn representation of the line. Explain that since we

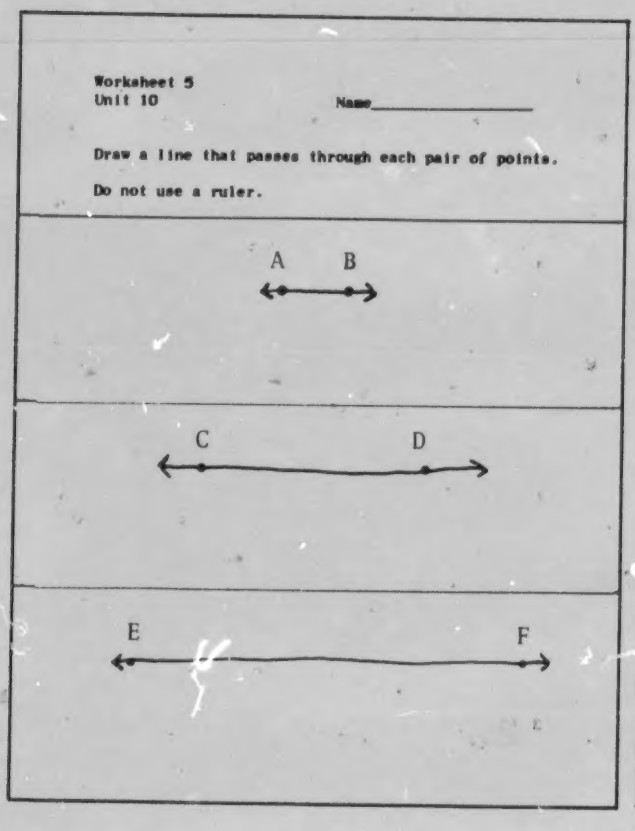
cannot draw a line that goes on forever, we indicate a line by drawing arrows at the ends of a line segment to show that the line goes on. Emphasize that we use the two points that are labeled to help us name the line. We name it line AB or $\overleftrightarrow{AB}$. Draw the notation $\overleftrightarrow{AB}$ on your chalkboard.

Draw another line on your chalkboard. Call it EF.



Explain to your class that this line is called line EF. The two points E and F help us determine a different line from line AB. Point out that the line segment EF is part of (a subset of) line EF, i.e., a line segment is a subset of a line.

Let each child complete Worksheets 5 and 6. The children draw lines without a ruler on Worksheet 5, but they do use rulers for Worksheet 6. You may have to furnish help, especially with the placing of the arrows. Tell the children that the arrows do not locate points, but only indicate that the line goes on forever.


Worksheet 5
Unit 10 Name_____

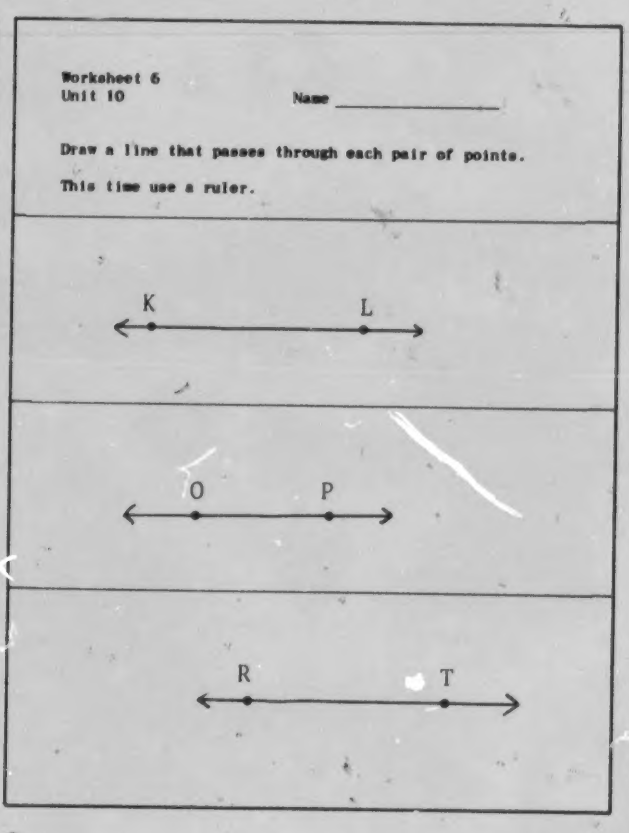
Draw a line that passes through each pair of points.

Do not use a ruler.

A B

C D

E F


Worksheet 6
Unit 10 Name _____

Draw a line that passes through each pair of points.

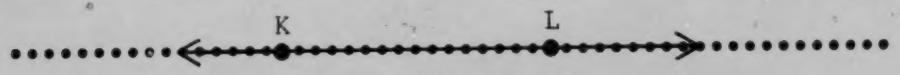
This time use a ruler.

K L

O P

R T

After the two worksheets have been completed, ask the children to find and draw as many dots on the lines of Worksheet 6 as they can. Have them draw the dots right on the line. Encourage them to squeeze in as many very small dots as they can. Remind them that the dots represent points and that points are very, very tiny. Then encourage them to draw points on the part of the line that extends beyond the arrow, like this:

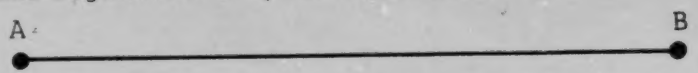


Next, have the children complete Worksheets 7, 8 and 9.

Worksheet 7 provides more practice in drawing lines. Let the children use rulers if you wish. Worksheets 8 and 9 provide practice in drawing line segments. You may want to provide extra practice in drawing lines and line segments with a pencil and ruler if your class requires it. One idea would be to place a large sheet of brown wrapping paper over a table and allow the children (during their spare time) to go to the table and practice drawing and labeling, points, lines, and line segments. When the paper has been filled, turn it over and use the other side.

Activity B

Draw a line segment AB on your chalkboard.



Ask if any of the children can think of other kinds of curves that can be drawn passing through the points A and B. You may wish to refer to some of the work in Unit 2, Curves and Shapes, in which the children worked with line segments.

Some of them wiggled:

Some were straight:

They were all called "curves."

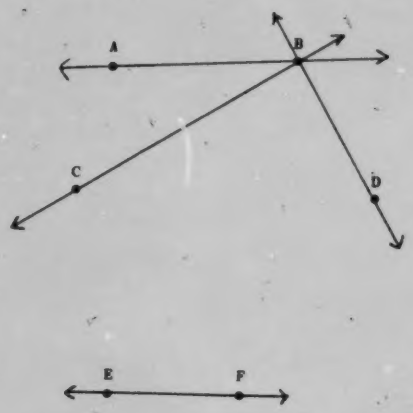
Tell the children that when we talk about "lines," we are referring to straight lines, or curves that are straight lines. Draw several examples of lines and other curves passing through two points on your chalkboard. Explain that only one line (straight line) can be drawn through the two points.

Help the children complete Worksheet 10.

Worksheet 7
Unit 10 Name_____

Draw lines that pass through A and B; C and B;
E and F; B and D.

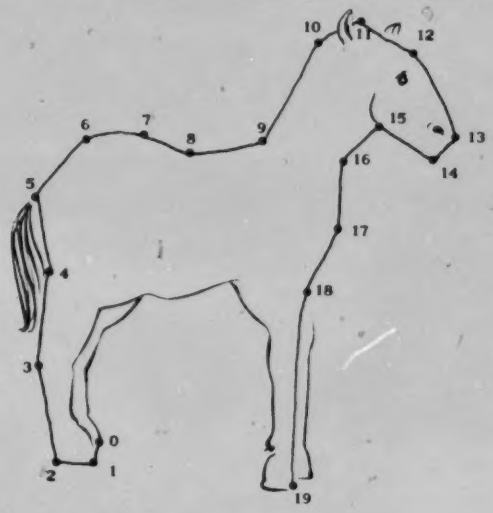
Use a ruler.



Worksheet 8
Unit 10 Name_____

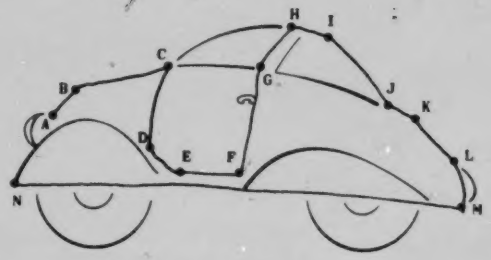
Draw line segments between the points.

Start with 0 and go in counting order.



Worksheet 9
Unit 10 Name_____

Draw line segments connecting the points. Start with A and then go to B, C, D, and so on.



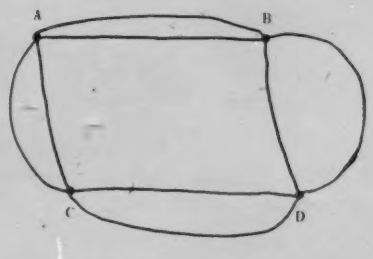
Worksheet 10
Unit 10 Name_____

Draw a line segment from A to B.
Draw another curve from A to B.

Draw a line segment from C to D.
Draw another curve from C to D.

Draw a line segment from A to C.
Draw another curve from A to C.

Draw a line segment from B to D.
Draw another curve from B to D.



Lesson 4: LINES DETERMINED BY THREE POINTS

In previous lessons the children worked with lines determined by two points. Here they work with geometric figures determined by three and four points that do not lie in a single line.

MATERIALS

-- for each child --

— pencil

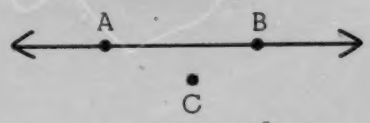
— ruler

— red, yellow, blue, green and orange crayons

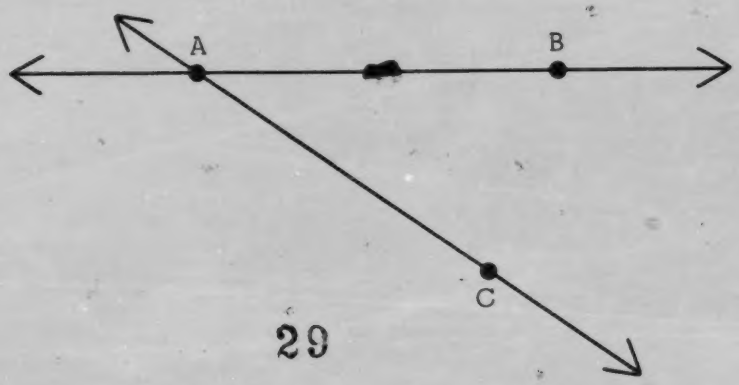
— Worksheets 11, 12 and 13

PROCEDURE

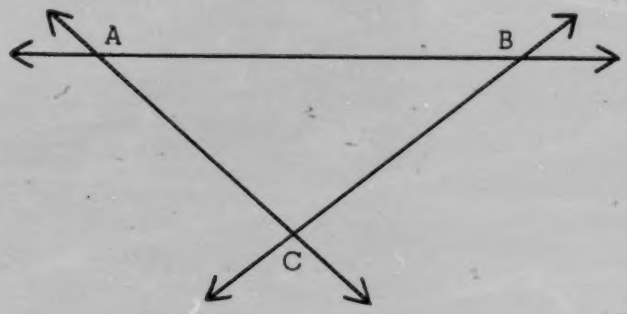
Have each child take out Worksheet 11, a pencil, ruler and a box of crayons. The children should work together during this activity. Ask one student what kind of geometric figure he sees on the worksheet. (Line AB or $\overleftrightarrow{AB}$; line segment AB or $\overline{AB}$; and points A, B, C.)



Draw the line and points on the chalkboard and fill in the answers as the children supply them. Have each child draw the line passing through points A and C, using pencil and ruler. Ask what the name for this line is. ($\overleftrightarrow{AC}$.) Then ask how many points there are on line AC. (Endless, many, etc.)



Continue by having the children draw the line that passes through points B and C. What is the name for this line? ($\overleftrightarrow{BC}$.) Ask how many points are on line BC. (An endless number.)



Lead a discussion of this new diagram by asking questions such as:

HOW MANY LINES DO WE HAVE? (3.)

HOW MANY LINE SEGMENTS DO WE HAVE? (3.)

FIND AND NAME THE LINE SEGMENTS. ($\overline{AB}$, $\overline{AC}$, $\overline{BC}$.)

FIND AND NAME THE LINES. ($\overleftrightarrow{AB}$, $\overleftrightarrow{AC}$, $\overleftrightarrow{BC}$.)

COLOR LINE SEGMENT AB RED.

COLOR LINE BC BLUE.

COLOR LINE AB YELLOW.

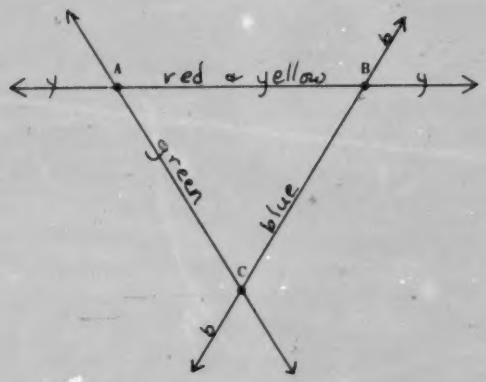
COLOR LINE SEGMENT AC GREEN.

Again, point out that a line segment is part of a line.

Have the children complete Worksheets 12 and 13.

Worksheet 11
Unit 10

Name_____



Worksheet 12
Unit 10

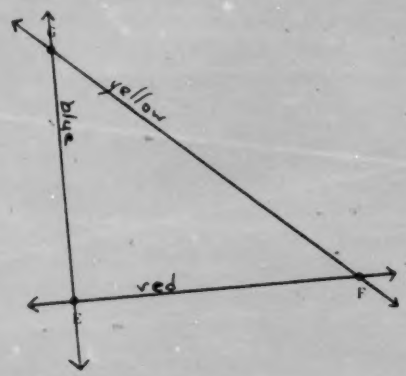
Name_____

Draw lines EF, FG and EG.

Color $\overleftrightarrow{EF}$ red.

Color $\overleftrightarrow{EG}$ blue.

Color $\overleftrightarrow{FG}$ yellow.

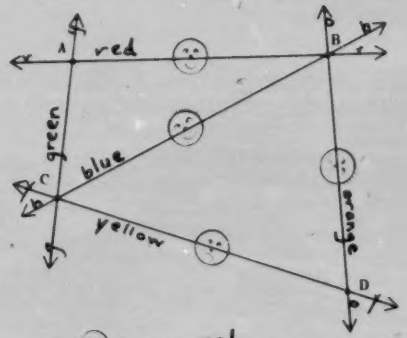


Worksheet 13
Unit 10

Name_____

Color $\overleftrightarrow{AB}$ red.
Color $\overleftrightarrow{CD}$ yellow.
Color $\overleftrightarrow{CB}$ blue.

Color $\overleftrightarrow{AC}$ green.
Color $\overleftrightarrow{BD}$ orange.



☺ is on the red line.

☺ is on the blue line.

☹ is on the yellow line.

☹ is on the orange line.

Lesson 5: SIGHTING ALONG LINES OF OBJECTS

In this lesson the children sight along lines of objects, and line up more objects by sighting. This is to demonstrate that any two objects, whatever they are, can always determine a straight line.

Children sometimes have difficulty imagining lines connecting objects when the lines are not actually there. These activities are designed to help them visualize lines that have not been drawn. You can use many everyday activities to help achieve this lesson's purpose. When your class stands in line or puts objects in a line, ask the children to imagine the invisible straight line on which all are located, and to point along imaginary extensions beyond the first and last objects.

The lesson starts with a story about explorers in Antarctica. It tells how these explorers lay trails, by placing tall flags in the deep snow, in order to find their way back to their base. In Activity B, the children become "explorers." Working in teams they lay out similar trails of flags on the floor. You will need a rather large area of floor space for this activity. Activity C reinforces the main concept of the lesson with a worksheet. Optional activities give the children opportunities to use themselves as reference objects (like the flags) to determine invisible straight lines.

MATERIALS

— 50 to 70 soda straws

— 1 razor blade or scissors

— 50 to 70 small triangles of orange paper to use as flags

— 50 to 70 small lumps of clay

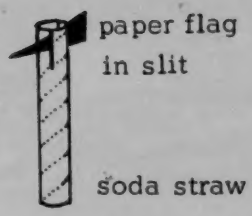
-- for each child --

— green, red, yellow and blue crayons

— Worksheet 14

PREPARATION

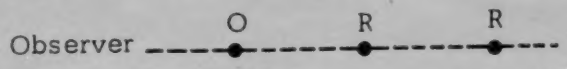
To make the flags for Activity B, cut a slit about three-fourths of an inch deep in one end of each soda straw. Insert a small triangle of orange paper in each slit. Have ready a small lump (about three-fourths of a cubic inch) of clay for each flag base. The children can insert the flags into the clay during the activity.



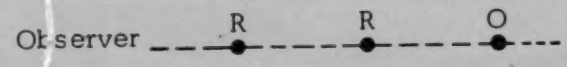
PROCEDURE

Activity A

Sighting with artificial reference objects is done as follows: Two reference objects are lined up in the chosen direction. Then an observer stands in such a way that one reference object is hidden behind the other. A third object is placed either so that it hides both reference objects,



or so that one of the reference objects hides both other objects.



These procedures may be repeated again and again to place many objects in a straight line. You can explain these procedures to the children during or after the telling of the story. They may be interested to know that the technique they will be using is similar to one used by explorers and scientists. This method of making trails was used by scientists working at the South Pole. Early explorers used it too. (This part of the lesson could be combined with a geography lesson.)

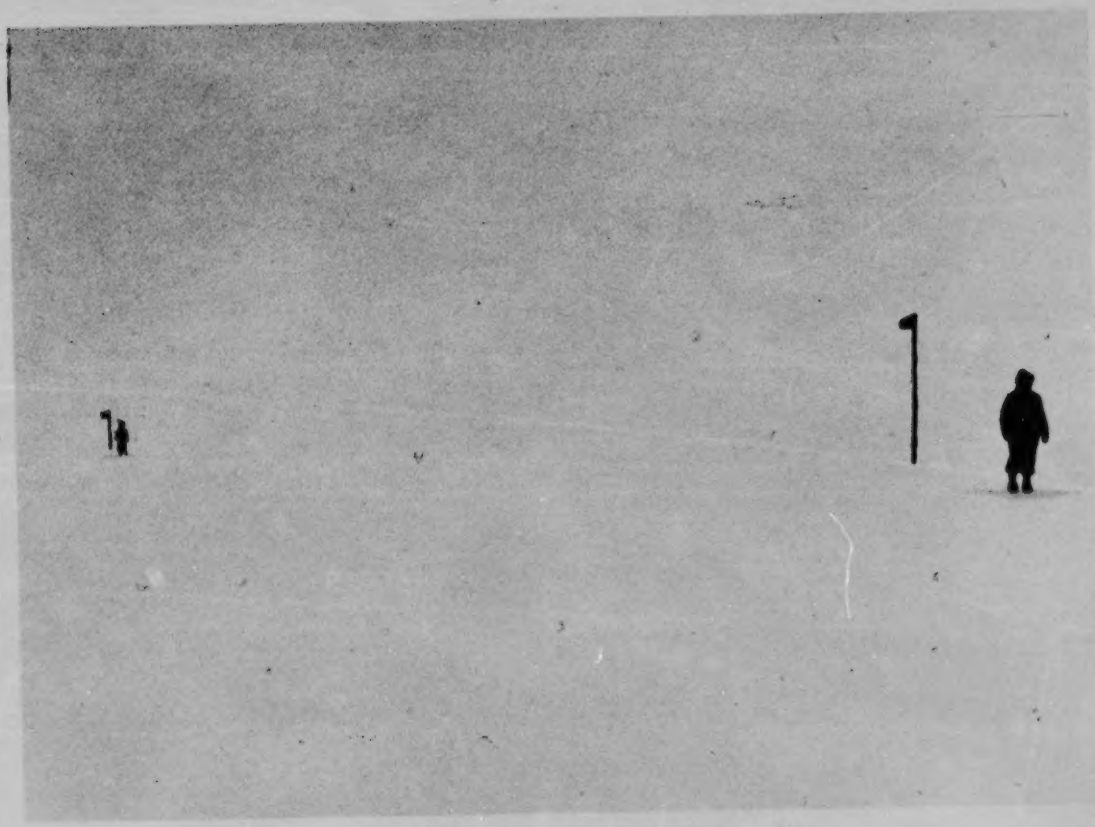
Tell the following true story in your own words.

LAYING TRAILS AT THE SOUTH POLE

What do you think of when you hear the words "South Pole?" Snow! Much of the Antarctic or South Polar ice cap is a flat sheet of solidly-packed snow. The snow is nearly a mile deep in some places. For miles and miles, there are very few landmarks for anyone to use as reference objects to tell where he is. We have streets and buildings and trees to tell us where we are, but Arctic explorers can travel for many days without seeing anything but a flat, white field of snow. When they are in some places, the explorers must lay some kind of trail, so that they can find their way back to camp, or so that other explorers can follow them. The tracks made by their feet would not help because they are quickly covered by blizzards and snow blown by the strong winds. So the explorers lay a trail of tall reference objects.

First they decide in what direction they wish to go. They poke a long stick with a flag on it into the snow. Then they use a second long stick to mark their direction. The straight line from the first stick to the second one shows the direction in which they are going. After they have placed these two reference flags, all their other flags will be located on the same straight line with those first two flags. They will keep extending the line.

To do this, the explorers travel on in the same direction for about a quarter of a mile beyond their second reference flag. Then they look back to be sure that they have gone in a straight line. The first flag should be hidden behind the



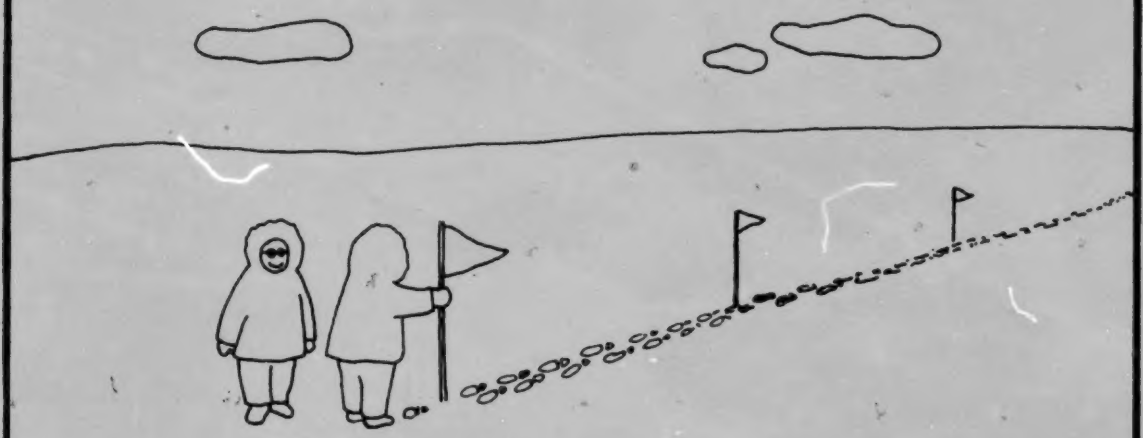
Two scientists are marking their trail in Antarctica by sighting to place flags in a straight line. Because of the blizzard, they have to stand closer to each other than they usually do.

second. If it is not, they must move to the left or the right until the first flag is hidden. Then they put the third flag in place. They place this flag in such a way that when they go on a little farther and look back, or "sight," squinting with one eye at the first two flags, the new flag hides the other two. The first two flags are directly behind the third flag, on the straight line which connects all the flags.

Every quarter of a mile or so, the explorers push another flagstick into the snow, sighting with one eye each time to

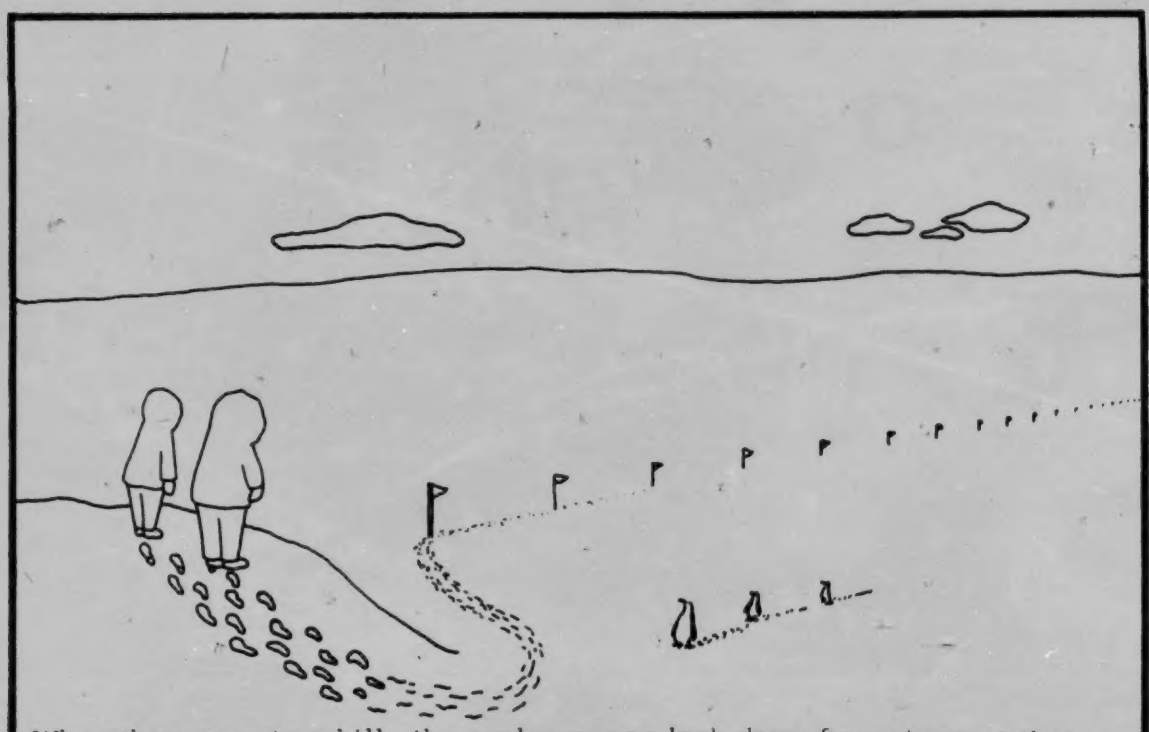
make sure that the new flag hides the flags already placed. As long as it does, all the flags are on nearly the same straight line.

Laying Trails at the South Pole



Standing in the snow, the explorers sight to place flagsticks in the snow. They sight back from their new flag, so that it hides the other flags behind it.

Sometimes the explorers come to a little hill. Then they can stand on the top of the hill and look back at where they have been. Often they can see as many as a hundred flags behind them, all in a straight line. Until it snows, they may even see a line segment connecting the flags. This is the trail of footprints they left as they walked in the snow. But even if the snow is blowing, they can still see the tall flags standing on an imaginary straight line. Then they go on, putting more flags in place as they go. In this way, thousands of flags can be put in straight lines, marking trails for many hundreds of miles across a huge sheet of ice and snow at the South Pole.



When they come to a hill, the explorers can look down from above at their flags, all placed on a straight line.

Lines of flag-sticks mark trails in Antarctica. High winds near the South Pole often tear the flags away. Sometimes the scientists and explorers just place bare sticks, since they know that flags would soon be torn away.

Both sides of this road are marked with lines of flags. Lines of flags and sticks mark other trails in the background. The tracks left by a snow vehicle's caterpillar treads will soon be covered with blown or fresh-fallen snow. Only the flag sticks will be visible to mark the road.

27

Activity B

Divide the class into teams of "South Pole explorers." Give each team about ten straw flags and an equal number of small lumps of clay. Explain to the children that, since there is no snow to hold up the flags, the clay will be used for that purpose. Say that each team is going to lay a trail across the floor, just as the explorers do, except that the classroom flags will have to be much closer together. There are two ways to lay out the trails. They are described on this and the following pages. If time is short, use Method I only. One child on each team should start out as the "sighter." He lies on the floor, squints at the line of flags, and tells his team where to place the next flag. Other children stick the flags into the lumps of clay carefully, so that the flags stand up straight and are ready for placement according to the sighter's instructions. Do not allow the children to use existing floor lines for their sightings.

Method I: Each team puts two reference flags about a foot apart to mark the start of the trail. (Leave these flags in place, if you are doing both methods.) Method I is like that used by the South Pole explorers. Several children in rotation -- not just one -- may do the sighting. A child should lie a foot or two from the reference flags, holding a third flag. Squinting at the flags through one eye, he places the third flag so that it nearly hides the first two.

Then he moves back a foot or so and places flag 4. It is probably best to have only one child at a time placing flags at first. When a child gets in position, even before he tries to hide the flags already in place behind the one he is to place, he should move his head around until most of the flags in place are hidden behind the one nearest him.

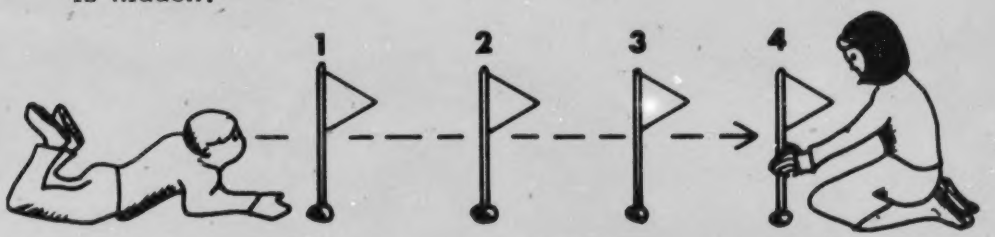
After all the flags have been lined up, have everyone look at the trails of flags from above, and note that they are nearly in a straight line. Children can take turns sighting along each trail to see if most of the flags are nearly hidden behind the first. (See the photo on the next page.)

Method I

Method 1

After the sighter has himself lined up with flags 1 and 2 so that 2 nearly hides 1, he places flag 3 so that it nearly hides 1 and 2. Then he moves back several feet to place flag 4, and so on.

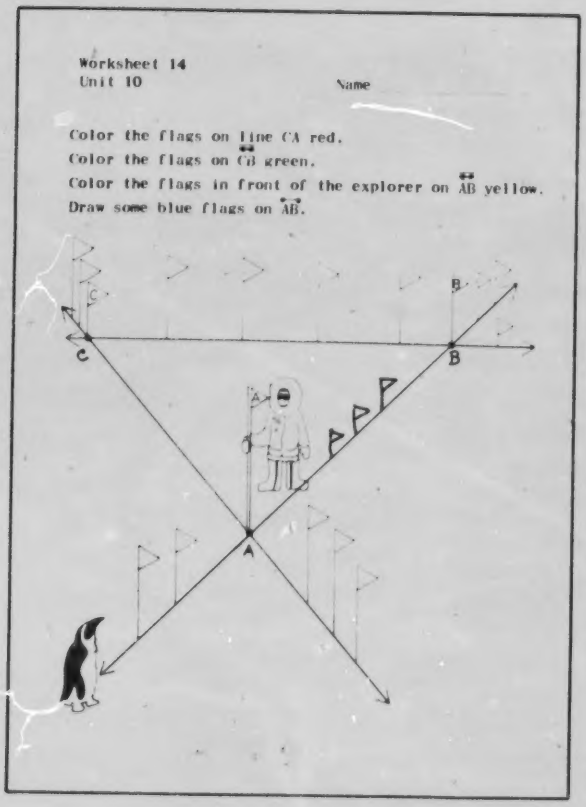
Method 2: The children in each team put a reference flag in place anywhere they choose. This is the start of the trail. Now each team decides which way it wants to go. The children place a second flag to show the direction. Then they lay a trail of flags that continues in that direction. Explorers take turns being the sighter. The sighter lies down a foot or two away from the flag marking the start of the trail and closes one eye. He moves around a bit until the second straw is partly hidden behind the first. (It is important that he sight with only one eye; otherwise the line will not be straight.) Then he directs a teammate to put the next flag in place so that it is partly hidden behind the other two. He should tell his teammates to move the flag one way or another until it is hidden.



Method 2

The sighter is sighting with his right eye. His left eye is closed. Flags 1 and 2 are the original reference flags placed by his team. Other children take turns placing flags 3, 4 and so on, as the sighter directs.

Method 2



Worksheet 14
Unit 10

Name

Color the flags on line CA red.
Color the flags on $\overleftrightarrow{CB}$ green.
Color the flags in front of the explorer on $\overleftrightarrow{AB}$ yellow.
Draw some blue flags on $\overrightarrow{AB}$.

Activity C

After the children have laid trails of flags, ask:

COULD WE CONTINUE TO LAY OUT FLAGS ON THIS SAME LINE, BEYOND THE PART THAT HAS BEEN DONE?

Have the children try this, by sighting from both ends. Have them extend the lines of flags in at least one direction to the wall of the room. Lead them to realize that if the walls were not in the way, they could continue laying out flags along this same straight line through other rooms, outside the building, and as far as they like.

Have the children use their crayons to color the flags on Worksheet 14. Read the instructions to them. Note that Flag C should be colored both red and green.

Optional Activities

Rope or yarn may be used to check the following optional sightings for straightness of line, after the children have done the sightings. These activities may be done either in the classroom or on the playground.

1. Have two children stand at least ten feet apart. Ask a third child to try to stand about fifteen feet away from one of them on the line he imagines going through the two children's feet.

To line himself up with them by sighting, he should get in a position where one child seems to be nearly hidden behind the other. Have a fourth child use chalk to trace the line that connects the three lined-up children.

2. Have four or five children try to line themselves up, at least six feet apart. If they wish, they may ask another child to help by sighting. Again, someone should trace the line on which the children are standing.

Lesson 6: LOCATIONS ON LINES (TWO REFERENCE POINTS)

The class has had experience with lines and line segments, and has determined a line using two reference objects. In this lesson, the children will learn how to describe locations on a line in terms of the two reference objects that determine the line. They will see that directions such as left and right are relative to their own positions, and will learn to describe directions in terms valid for any observer.

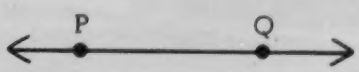
MATERIALS

- 10 feet of yarn; cards; tape
- red, green and blue chalk
- Worksheets 15, 16 and 17

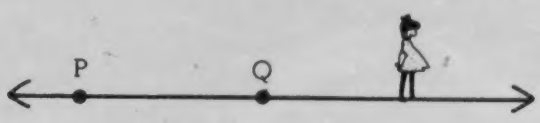
PROCEDURE

Activity A

Stretch 10 feet of yarn on your classroom floor. Use cards to label two points, P and Q about three feet apart. Tape the cards and the yarn to the floor.

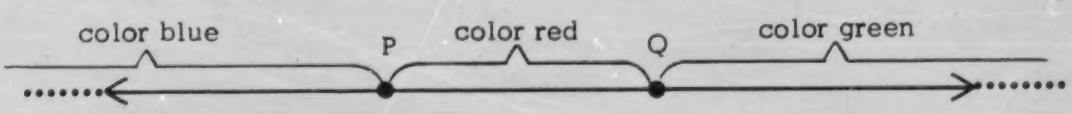


Gather your class around this line, some on each side. Have one of the children stand on the line segment PQ. Say that he represents a point. Ask the class to describe where he is standing. (On the line PQ between points P and Q, or on line segment PQ.) Be sure to discuss both answers. Record them on the chalkboard. Then have the child move along the line, beyond point Q.

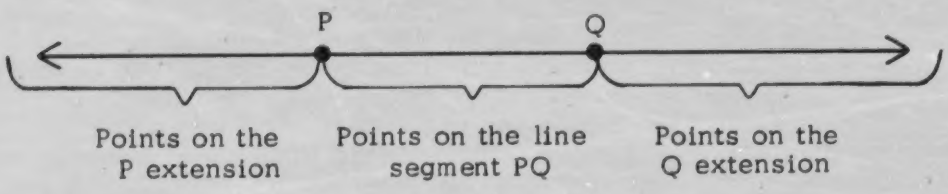


Ask the children on both sides of the line to describe where the child is standing now. The children on one side of the line can correctly say that the child is "to the right of Q." Just as correctly, the children on the other side of the line can say the child is "to the left of Q." This is your opportunity to point out to the children that what is "to the right" for one person can be "to the left" for another, depending on where the observer is. In this case, it depends on which side of the line the observer has chosen. Suggest that a better method of describing the child's location on the line is needed -- a description that all observers could use.

Draw a long line on the chalkboard and mark points P and Q. Give one of the children a piece of red chalk and ask him to color line segment PQ red. Ask the class if all of the points on line PQ are colored. (No.) Let another child color the points away from Q (to the right of Q) green. Still another should color the points away from P (to the left of P) blue. Remind the children that they could continue forever to color points blue or green, if that were physically possible. Add a few green and blue points beyond the arrows to help clarify this idea.



Now, have a child place his finger on different locations along the line and have the class describe each location. (On the blue points, red points, or green points.) Explain to the children that they need to find a way to describe these points without using colors, since not every line has differently colored points. Suggest that the children agree to call the green points "the points on the Q extension," and the blue points "the points on the P extension."

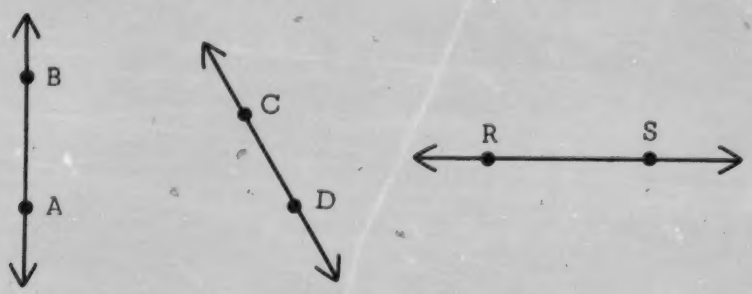


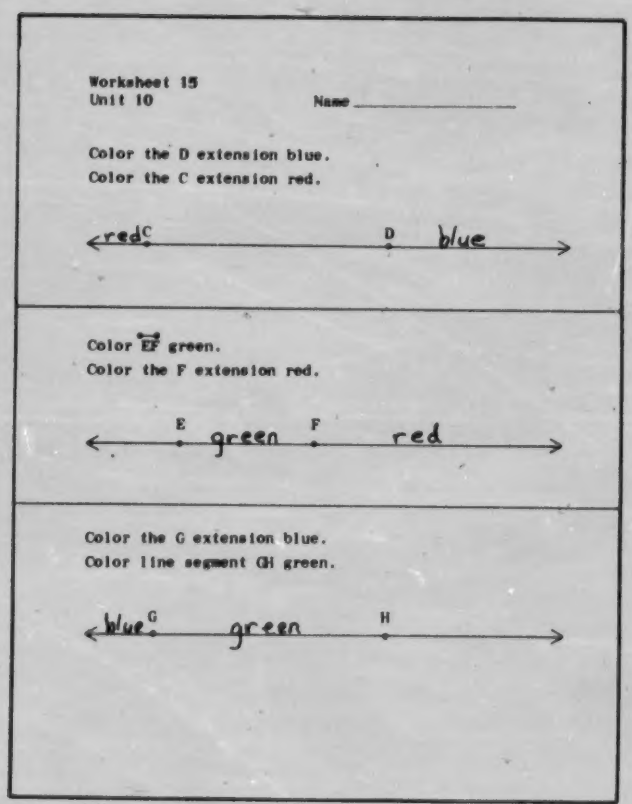
Continue the work of describing locations with questions like:

I'M ON LINE PQ, BUT I'M NOT ON THE P EXTENSION NOR ON THE Q EXTENSION. WHERE AM I? (On segment PQ.)

I'M ON LINE PQ BUT I'M NOT ON SEGMENT PQ NOR ON THE Q EXTENSION. WHERE AM I? (On the P extension.)

Repeat this procedure with other diagrams. Use lines in several different positions, like these:





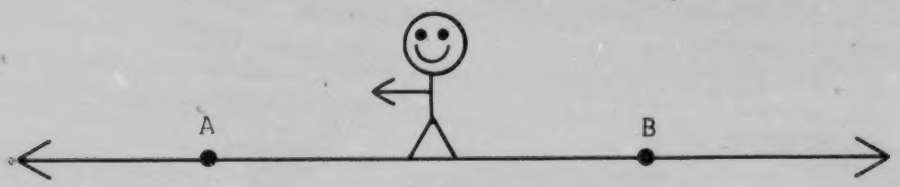
Point to the D extension (such as that shown in the second figure above) and ask your class to describe the location of that set of points. (On line CD, on the D extension.) Continue by pointing to various parts of your lines and having the children describe the location of each set of points.

On Worksheet 15, the children will continue this work independently. You will have to read the instructions to them, but do not guide them through the work as a class.

Activity B

Draw line AB on your chalkboard. Explain to the children that they are now not only going to locate points on the line, but they are also going to determine the direction in which an object is moving along this line. Tell the children that you are going to use "Smiley" to help them determine these directions. Draw a picture of Smiley on your chalkboard.

Draw Smiley on line segment AB, pointing toward A.

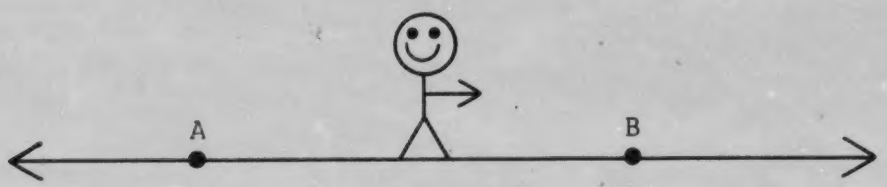


Ask:

WHERE IS SMILEY? (On line segment AB.)

HOW CAN WE DESCRIBE THE DIRECTION IN WHICH SMILEY IS POINTING? (Toward point A.)

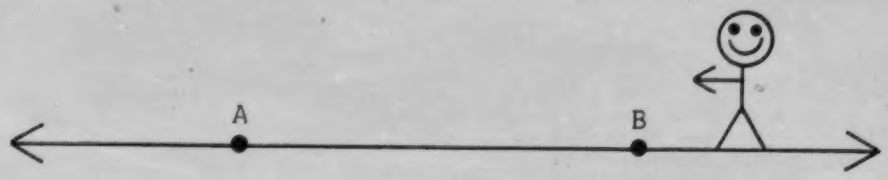
Now draw Smiley on $\overrightarrow{AB}$, pointing toward B.



NOW WHERE IS SMILEY? (On line segment AB.)

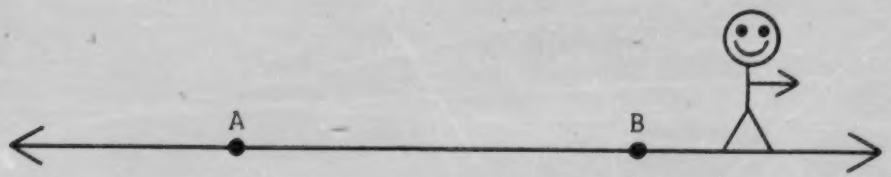
IN WHAT DIRECTION IS HE POINTING? (Toward point B.)

Draw Smiley on the B extension, pointing toward B.



Ask where Smiley is and in what direction he is pointing. (On the B extension, pointing toward B, or toward A. Either answer -- toward B or toward A -- is acceptable, but encourage the "toward B" answer.

Now draw Smiley on the B extension, pointing away from B, and ask the children to describe in what direction he is pointing.

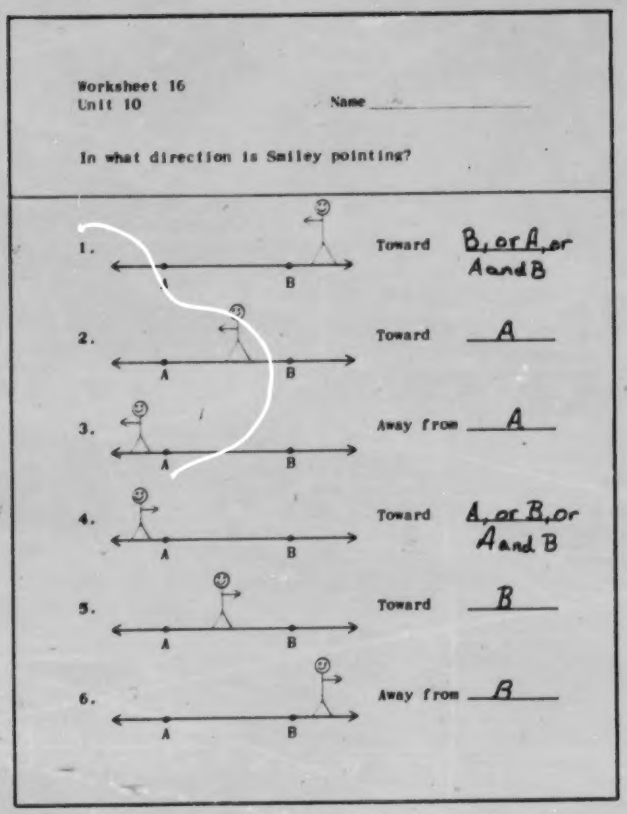


Repeat the above procedure after placing Smiley on the A extension.

WE HAVE NOW DESCRIBED SMILEY IN THREE DIFFERENT LOCATIONS, POINTING IN TWO DIFFERENT DIRECTIONS:

1. ON LINE SEGMENT AB, POINTING TOWARD A OR TOWARD B
2. ON THE B EXTENSION, POINTING TOWARD OR AWAY FROM B
3. ON THE A EXTENSION, POINTING TOWARD OR AWAY FROM A.

Have the children turn to Worksheet 16. Note that in Problems 1, 3, 4 and 6, a number of different answers are correct. For example, in the first problem, Smiley could be described as pointing toward A, toward B, or toward A and B.

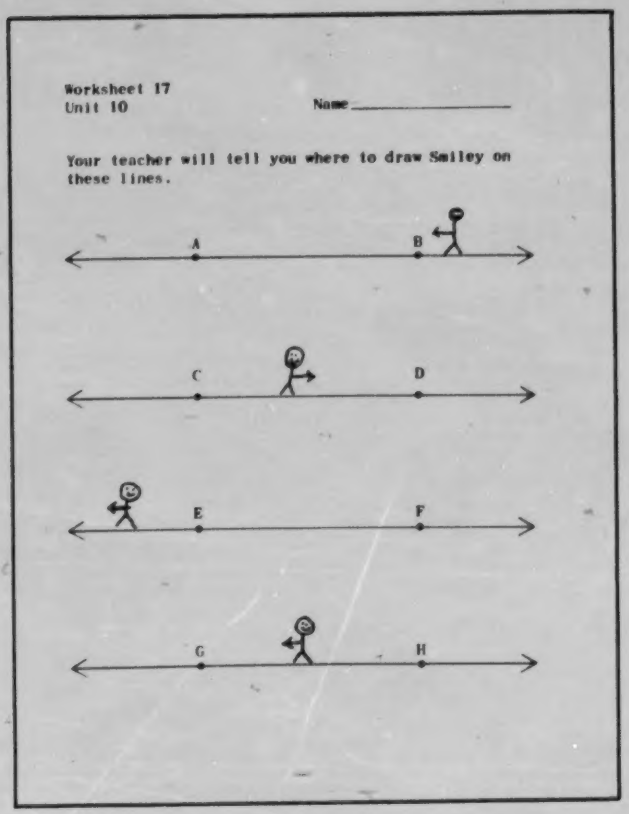


Worksheet 16
Unit 10

Name _____

In what direction is Smiley pointing?

1. Toward B, or A, or A and B
2. Toward A
3. Away from A
4. Toward A, or B, or A and B
5. Toward B
6. Away from B



Worksheet 17
Unit 10

Name _____

Your teacher will tell you where to draw Smiley on these lines.

On Worksheet 17 there are four lines on which the children should draw "Smiley" as you direct. For example, on line AB ask them to draw Smiley on the B extension pointing toward B. You should give directions such as this for each of the four lines on the worksheet. Circulate among your class to see if the children are locating Smiley correctly.

Additional Activities

These games may be played indoors or out. Draw a line that connects two objects on the playground, or stretch yarn out on the classroom or gymnasium floor. It may be necessary to put reference objects on the lines. If so, be sure to use two distinctly different objects such as a book and a doll, rather than two books.

1. Which Way Am I Pointing? A child stands facing either way on a line that has two reference objects on it. He may be between the objects or beyond them. He points along the line in either direction. Other children describe his location and tell which way he is pointing, in terms of the reference objects. (For example, he may be between the flagpole and the front door, pointing toward the flagpole.) The child who describes the location correctly becomes the next pointer.

2. Point the Way I Say: Three children stand on a line, one between two reference objects and one beyond each object. The rest of the children take turns calling out direction descriptions and the appropriate child on the line points in the direction described. For example, a child calls "On book extension, pointing toward book," and the child standing on that segment of the line points as directed. Anyone pointing the wrong way is out, and another child takes his place. For variety, have a child move along the line in a given direction.

Lesson 7: LOCATIONS ON LINES (THREE REFERENCE POINTS)

This lesson extends the concepts of Lesson 6 to a three-point diagram. More practice is provided in describing locations and directions, and in identifying lines and line segments.

MATERIALS

— colored chalk (green, red, blue)

-- for each child --

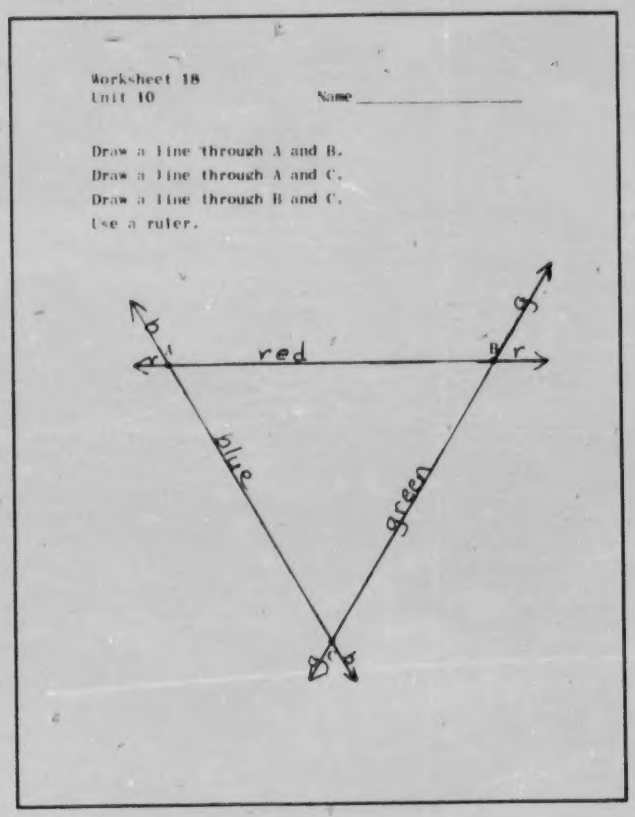
— green, red and blue crayons

— pencil and ruler

— Worksheets 18, 19, 20, 21 and 22

PROCEDURE

Activity A



Have the children turn to Worksheet 18. Draw a similar set of three points on your chalkboard. Let your class use pencils and rulers to draw lines AB, AC and BC. Do not draw the lines on the board until the children have had a chance to do the work independently. Then they can use your diagram to check their work.

Continue by having your class color line AB red, line AC blue, and line BC green. After they have colored their lines, use colored chalk for your chalkboard diagram. Discuss this diagram by asking questions such as:

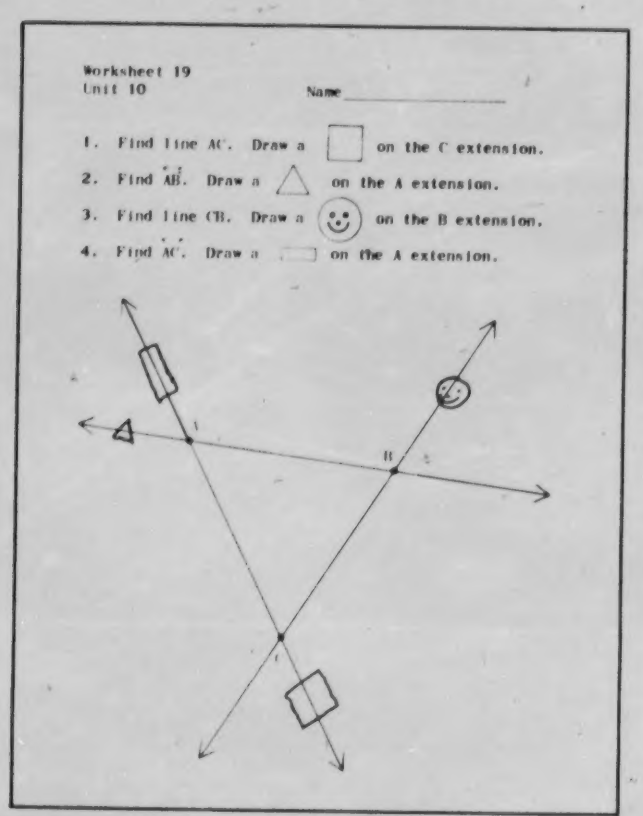
ON WHAT LINE IS POINT A? (On both AB and AC. Point A is on the intersection of the two lines.)

Repeat for points B and C.

Point to a location on the C extension of line AC and ask your class to describe this location. If a child simply says, "On the C extension," show that this is an inadequate description because both lines AC and BC have C extensions. The correct answer is "On line AC, on the C extension."

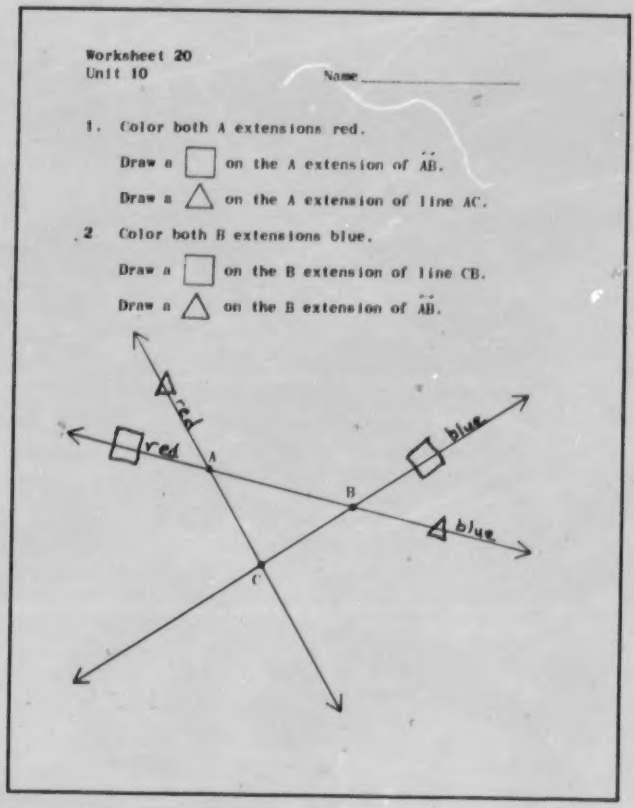
Point to various locations on the diagram and have different children name the correct locations. Remember that a line is named by two points, and direction is indicated in relation to one of the points.

Help the children complete Worksheets 19 and 20. The entire class will have to work on these at the same time, step by step, as you read each part of the instructions, but do not work out the answers for the children.


Worksheet 19
Unit 10

Name _____

1. Find line AC. Draw a ☐ on the C extension.
2. Find $\overleftrightarrow{AB}$. Draw a △ on the A extension.
3. Find line CB. Draw a ☺ on the B extension.
4. Find $\overleftrightarrow{AC}$. Draw a ▭ on the A extension.


Worksheet 20
Unit 10

Name _____

1. Color both A extensions red.
   Draw a ☐ on the A extension of $\overleftrightarrow{AB}$.
   Draw a △ on the A extension of line AC.
2. Color both B extensions blue.
   Draw a ☐ on the B extension of line CB.
   Draw a △ on the B extension of $\overleftrightarrow{AB}$.

red
red
blue
blue
A
B
C

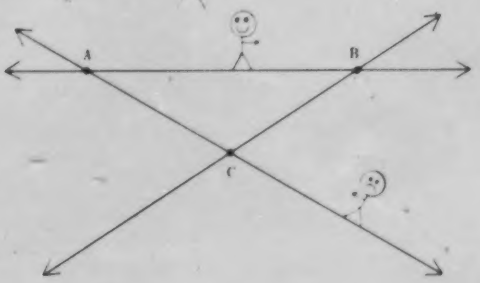
Worksheets 21 and 22 are concerned with direction as well as location. The new figure on these worksheets is called Grumpy. Help your class complete these worksheets.

Worksheet 21
Unit 10

Name_____

This is Grumpy.

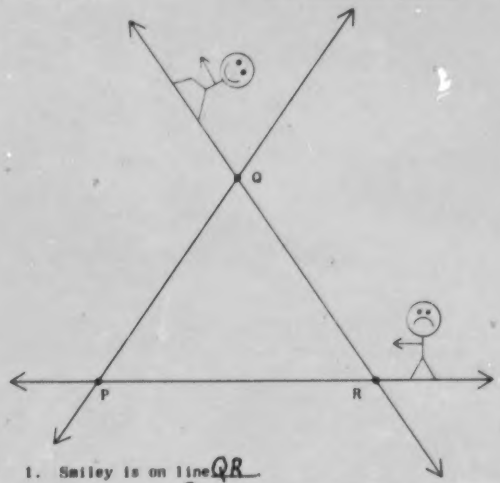
This is Smiley.



1. Grumpy is on the C extension of $\overleftrightarrow{AC}$.
   He is pointing toward C. (or A, or A and C)
2. Smiley is on line segment AB.
   He is pointing toward B.

Worksheet 22
Unit 10

Name_____



1. Smiley is on line QR.
   He is on the Q extension of line QR.
   He is pointing away from Q. (or R, or Q and R)
2. Grumpy is on line PR.
   He is on the R extension of line PR.
   He is pointing toward R. (or P, or P and R)

Lesson 8: READING THE TREASURE MAP

This summary lesson uses a story, and a map for finding buried treasure, to apply and further develop the skills presented in Section I of this unit. A location is described in terms of objects -- that is, the treasure is buried under a tree on the sandpit extension of a line that passes through a rocky hill and the sandpit. The children discover (Worksheet 23) that this is not a precise enough description of the location to lead them to the treasure. Many lines, rather than just one, can be located by such a description, because the reference objects are so large that many lines can be drawn through them. It is only when the reference objects are much smaller (as on Worksheet 25) that the correct line can be drawn and the treasure found. Though we do not expect first-grade children to realize that, by mathematical definition, points have no size -- that they are "smaller than small" -- we do like to lead them toward an eventual understanding of that definition. In this lesson we simply let the children discover that the best representation of each point should be so small that only one line can be drawn through a pair.

MATERIALS

- transparency (not provided) of Worksheet 23
- grease pencil for marking the transparency
- overhead projector

-- for each child --

- ruler
- pencil
- Worksheets 23, 24 and 25 (2 copies of Worksheet 23 are provided in the Student Manuals)

PROCEDURE

Tell or read the story, "Finding the Treasure," to the class. At appropriate places, stop to let the children try to find the buried treasure. If you do not use an overhead projector, you

should make a careful reproduction of the treasure map on the board or in the sandbox, with accurate positioning of the various reference objects (sandpit, rocky hill, palm trees, etc.).

Because so many children have difficulty in drawing lines straight enough to solve the lesson problem, they each have two copies of Worksheet 23. If the practice provided by this extra copy is not enough, you may want to give the children some art activities that will help improve this skill before going on with the lesson.

OCEAN

FINDING THE TREASURE

Young Joey's best friend was a retired pirate name Jolly Roger. Joey admired the black patch over Jolly Roger's left eye. He loved to listen to the exciting stories old Roger told about battles he had fought at sea, and about his narrow escapes from the Royal Navy or from other pirate gangs.

One day Jolly Roger told Joey something exciting. "Joey," he said, "you're young and strong and smart and brave. I'm a weak, tired, cowardly old man. My days of adventure are over, but yours are just beginning. I'm going to tell you where I buried some treasure. We took it after we fought Mean Mike McGraw, the wickedest pirate ever to sail the seven seas. It's buried on a small island not far from here. If you dig it up, I'll give you half of it."

"Swell," Joey said. "I'd like to have a treasure. Gold and jewels -- I could buy lots of toys and candy with those. And the fancy swords you told me about. I'd like to have one of those! And my mom might like that diamond crown that belonged to the wicked King of Castalia. Can you describe the treasure's location, so I can find it? The island is pretty big; I don't think I can dig all over it."

"I can do better than that, my boy. I've got a map," Jolly Roger said. "But you must be careful. Mean Mike McGraw's pirate gang is living on the island now. They know I buried the treasure there somewhere, and they're just waiting to get it back."

"Gosh," Joey exclaimed. "I don't want to tangle with them! What shall I do?"

"You won't have to tangle with Mean Mike," said Jolly Roger. "Mean Mike McGraw and his gang stay up all night, watching for someone to sneak in at night to dig up the treasure. Then they sleep all day. They don't expect anyone then. They'll never catch you, if you go there in the daytime."

"That's what I'll do, then," Joey decided. "Give me the map, and I'll be on my way."

"Just a moment, lad," Jolly Roger said. "The treasure is buried deep. It will take you all day to dig the hole to get it out. You must be sure you dig in the right place, because if Mean Mike McGraw and his gang see an empty hole you dug by mistake, they'll know you'll be back to dig again, and they'll be watching for you. You can only fool them once by digging in the daytime."

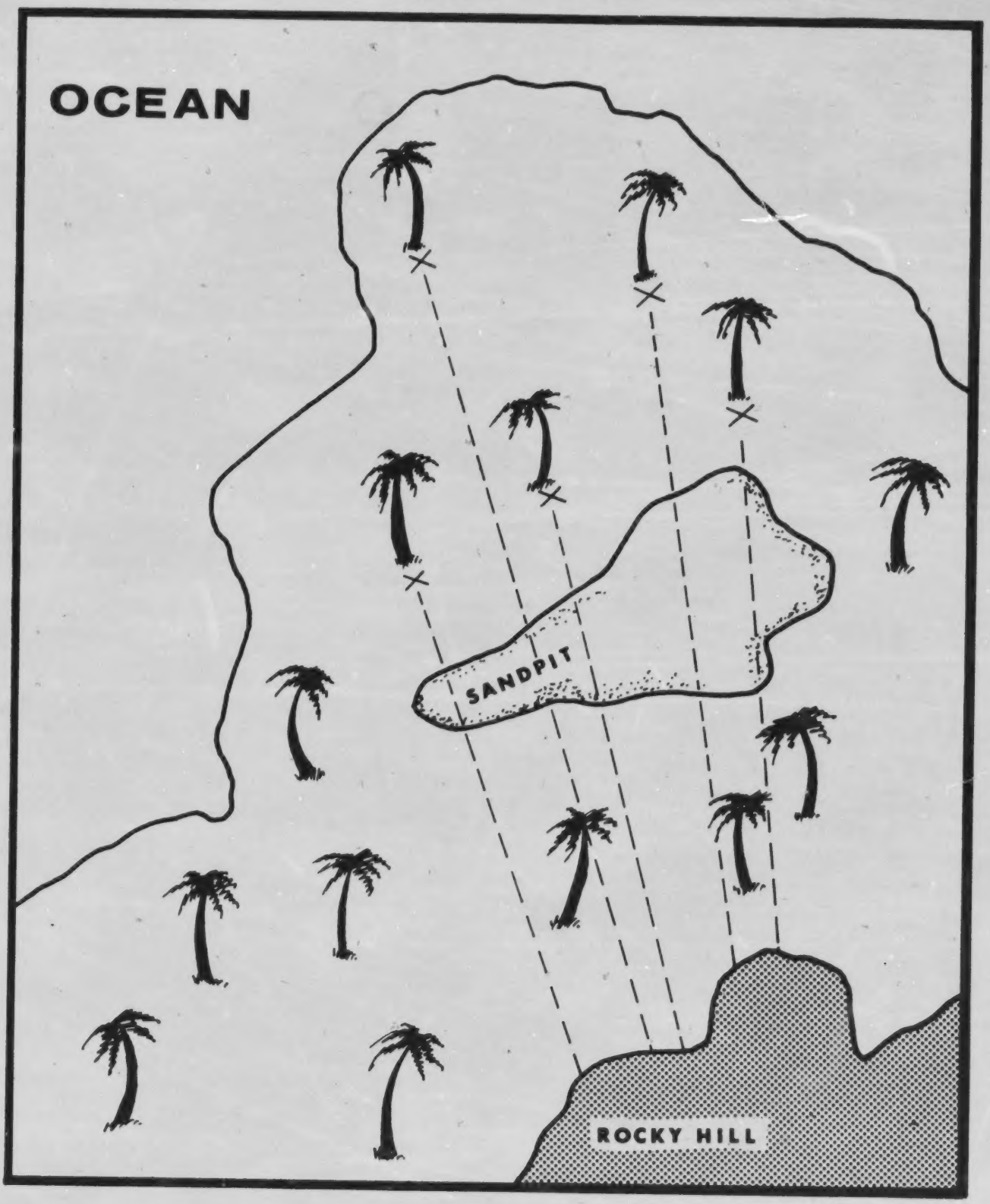
"All right," Joey said. "I'll go and scout around at first, but if I'm not sure I have the right place, I won't dig. I'll come back and ask you more questions. Then they won't know anyone was there in the daytime."

"Smart lad," Jolly Roger said. "Here's the map. The treasure is under a palm tree. If you dig a hole in the tree's shadow at high noon, you'll find it."

"But there are a lot of palm trees on the island," Joey objected. "I can see a great many from here."

Worksheet 23 (with answers)
Unit 10

Name _____



"Eh, you're a sharp one," Jolly Roger exclaimed. "But what do you think the map is for? It shows where the palm tree is located. The tree with the treasure is on the same line as the rocky hill and the sandpit, in the direction away from the sandpit. Here's the map. Good luck, lad!"

Taking the map, Joey got into his rowboat and headed for the island.

. . . . . .

Have the children turn to Worksheet 23, which is a copy of Jolly Roger's map. Project your transparency of the map. Repeat Jolly Roger's description of the location of the tree, and ask the children which of the trees might be the right one. REMEMBER, the treasure is buried under a palm tree on the sandpit extension of a line going through the rocky hill and the sandpit. Have a child draw a line that goes from the rocky hill through the sandpit and to a palm tree.

IS THAT THE ONLY POSSIBLE TREE? (No.)

Ask each child to draw on his own worksheet all the possible lines that would fit Jolly Roger's description. Then have children take turns showing on the transparency one of the lines they drew.

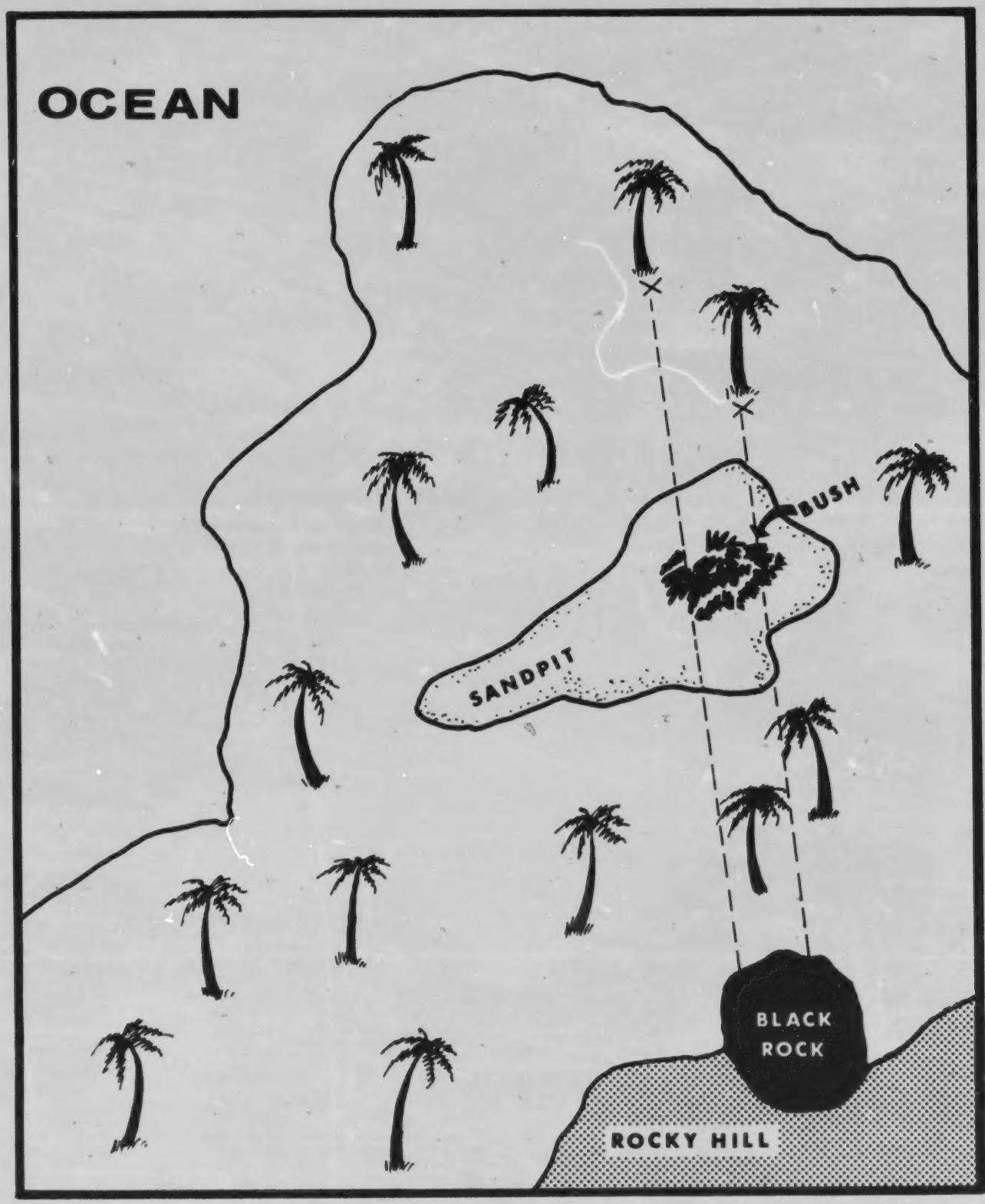
DID JOLLY ROGER GIVE A GOOD ENOUGH DESCRIPTION OF WHERE HE BURIED THE TREASURE? (No, there are too many possible trees.)

. . . . . .

Joey found the same thing we did. He drew lines in the soft sand of the island, using a stick, as he walked in the direction from the hill to the sandpit, and then on in the same direction beyond the sandpit. The first line Joey drew went all the way to the end of the island, and there wasn't any

Worksheet 24 (with answers)
Unit 10

Name _____



palm tree on that line at all! Then he tried several other lines that connected the hill and the sandpit and extended beyond the sandpit.

There were palm trees on many of the lines. Poor Joey. He didn't know which tree had the treasure under it. He didn't dare make a guess and start digging, for if he guessed wrong, Mean Mike McGraw's gang would be waiting for him the next day. So he took a palm leaf and swept away all the tracks he made in the sand, and then he went back to Jolly Roger and explained his trouble.

"Umph," Jolly Roger grunted. "The problem is that the hill and the sandpit are too big. There are too many lines that connect them. Hmm, let me think now."

"We need smaller reference objects," Joey said.

"So we do. Well, when I made the map, I remember I started my line from a big black rock on the rocky hill. And I drew it to a bush growing in the sandpit. I'll mark them on the map for you, so they'll be easy to find."

The next day, Joey took the marked map, and started for the island again.

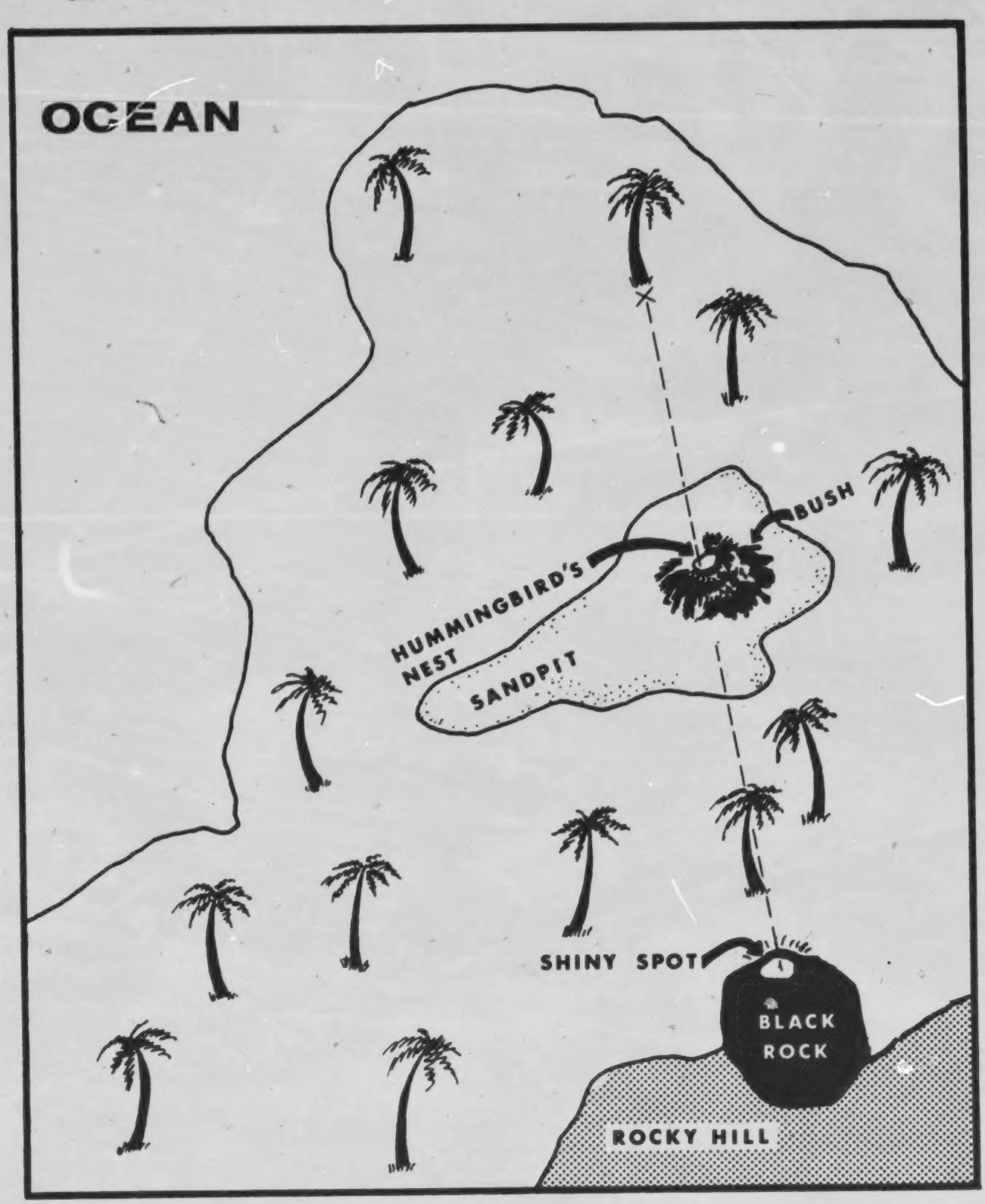
. . . . . .

Lay your transparency of Worksheet 23 over a copy of Worksheet 24 and trace on it the additional reference objects (the black rock and the bush). Then project the transparency and have the children turn to Worksheet 24. Ask the children whether they think this map is an improvement on the last one.

WILL JOEY BE ABLE TO FIND THE TREASURE NOW?

Worksheet 25 (with answers)
Unit 10

Name _____



Repeat the previous procedure. Have a child draw one possible line fitting the description.

ARE THERE ANY OTHER POSSIBLE LINES? (Yes.)

Have the children draw them on their worksheets, and then have someone draw on the transparency. Then go on with the story.

. . . . . .

Joey found that when he drew lines according to the new instructions, there were two lines that passed through palm trees after they passed from the rock to the bush. Joey didn't dare to try guessing which was the right tree. He went back to Jolly Roger again.

"The reference objects are still too big, Jolly Roger," Joey complained. "I can draw a lot of lines connecting them, and two of the lines have palm trees beyond the bush."

"Umph," Jolly Roger muttered. "Let me see, now. Draw your line from the shiny spot on the black rock to the hummingbird's tiny nest in the branches of the bush and extend it on beyond the bush. That should do it, lad."

. . . . . .

Trace onto your transparency the shiny spot on the rock and the hummingbird's nest on the bush, shown on Worksheet 25. Have the children turn to Worksheet 25. Ask if Jolly Roger's instructions now are good enough so that Joey can find the one palm tree under which he should dig to find the treasure. They should find that they can draw only one or two lines connecting the spot on the rock and the dot representing the hummingbird's tiny nest. Just one palm tree will be on one of these lines on the nest extension. (There is another palm tree on this line between the spot and the nest.)

. . . . . .

DID JOEY FIND THE TREASURE?

Have the class make up an ending to the story.

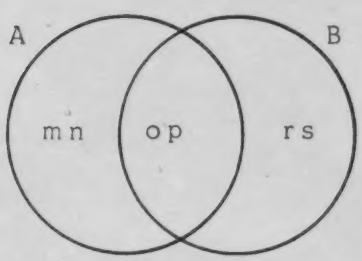
SECTION 2 LOCATIONS AND MAPS

Making and reading maps are interesting applications for location skills that draw on much of the material studied in Section 1. In the lessons of that section the children learned that a line is made up of points, that it is of infinite length, and that it lies between -- and extends beyond -- a pair of points. The children also learned how to describe direction and to locate objects on a line.

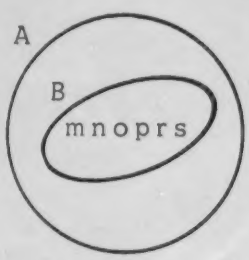
In this section we add work with the concepts of intersecting lines and intersecting regions. The children first learn to locate a point or a set of points from your description of the location. Then they learn to describe such locations themselves. Much of the material in this section lays the groundwork for the children's future study of coordinate systems and graphing on grids.

Note that it is very important, when teaching intersections and unions, to use the words "or" and "and" correctly. Remember that when you are talking about the members of the intersection of two sets (say sets A and B), you are talking about members that are in both set A and set B. When you are talking about members of the union of two sets, you are talking about members of set A, or of set B, or of both sets. For example, given a set A = { m, n, o, p } and a set B = { o, p, r, s }, a member of the set which is the intersection of set A and set B is a member of set A and of set B. The intersection set is { o, p }. A member of the set which is the union of set A and set B is a member of either set A or set B, or of both sets. The union set is { m, n, o, p, r, s }.

Intersection



Union



Lesson 9: INTERSECTIONS AND UNIONS

Yarn and property blocks are used to demonstrate the following concepts: (1) The intersection of two straight lines is either one point or, in the case of parallel lines, the empty set. (2) The union of two lines is all of the points on both the lines. (3) The intersection of two regions is the region common to both of them. (4) The union of two regions is all of the region or regions enclosed in the two closed curves.

MATERIALS

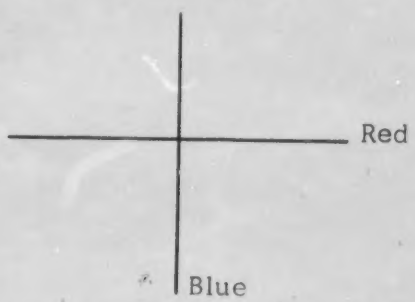
- 2 ten-foot pieces of yarn (1 blue, 1 red)
- 1 set of property blocks
- blocks colored both red and blue
- Worksheets 26, 27 and 28

PROCEDURE

Activity A

Before the lesson begins, gather together from your property blocks all the red blocks and all the triangular blocks. Put the red triangular blocks out of sight.

Arrange the two lengths of yarn of different colors (say red and blue) on the floor so that they form two intersecting lines like this:



Call on various children to place all of the red property blocks that you have in sight on the red line in such a way that the blocks do not touch the blue line. Then have other children

put the triangular blocks on the blue line in such a way that the blocks are not touching the red line.

HOW CAN WE DESCRIBE THE LOCATION OF THE SET OF TRIANGULAR BLOCKS? (The set is on the blue line.)

HOW CAN WE DESCRIBE THE LOCATION OF THE SET OF RED BLOCKS? (This set is on the red line.)

Now bring out the red triangular blocks that you have kept out of sight, and give one to a child. Ask him to place it on the yarn wherever he thinks it should go. If he has trouble, have him tell what set the block belongs in, and where that set is located. Then ask if this block belongs in the other set, too.

WHERE CAN YOU PLACE THIS RED TRIANGULAR BLOCK SO THAT IT WILL BE IN BOTH SETS? CAN YOU PLACE IT SOMEWHERE SO THAT IT WILL BE ON THE RED LINE AND ALSO ON THE BLUE LINE -- A PLACE THAT SATISFIES THE LOCATION DESCRIPTION FOR BOTH THE SET OF RED BLOCKS AND THE SET OF TRIANGULAR BLOCKS? (The child should place the block on the only place that fits the description -- the point of intersection of the two lines.)

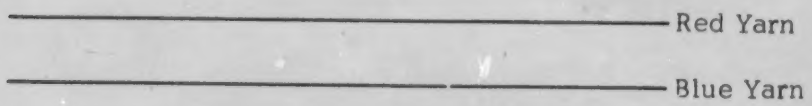
Give another red triangular block to another child and repeat the procedure. When he determines the correct location, have him place the second block on top of the first one, at the intersection of the lines.

HOW CAN WE DESCRIBE THE LOCATION OF THE RED TRIANGULAR BLOCKS? (They are at the intersection of the red and blue lines.)

Remind the children that, since a line is a set of points, this intersection is just one point.

IS THERE ANOTHER POINT THAT IS ON BOTH THE RED AND BLUE LINES? (No.)

Remove the blocks and place the pieces of yarn so that they are parallel:

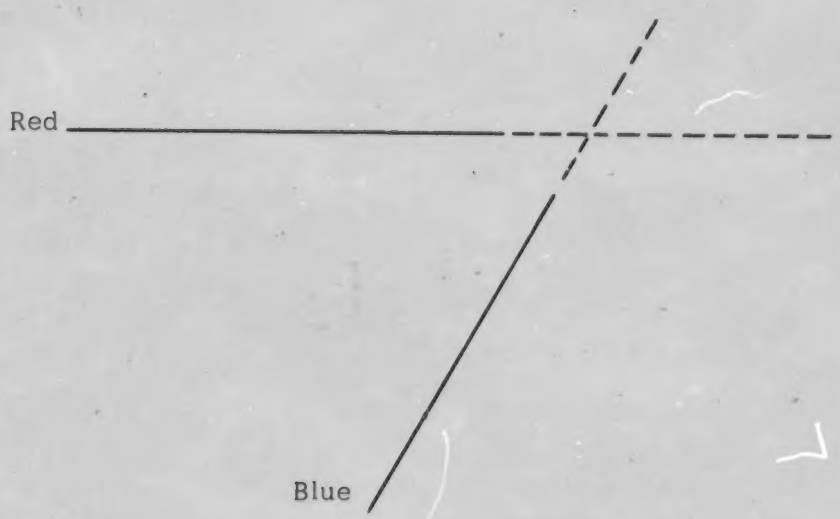


You may wish to have two children walk along the lines to give the class an intuitive idea of parallelism.

Now put all the blocks in one pile. Ask the children to put on the red line only those blocks that are red and not triangles. Then ask them to put on the blue line only those blocks that are triangles and not red.

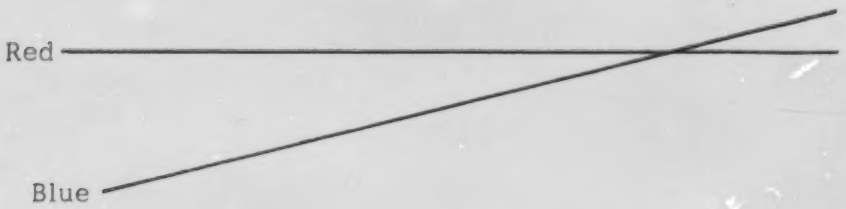
Not ask where we can put the blocks that are left, the red triangles. They can only be properly placed at the intersection of the lines. But there is no intersection. The intersection set is the empty set. So the red triangles must be left to one side.

Now gather all the blocks again and place the pieces of yarn so that they form lines that will intersect if we imagine their extensions.



Let the class sight or trace along the two lines until they determine the intersection point. Ask a child to place a block on the intersection set. Remind the class that this intersection set has only one member (one point).

Move the yarn lines again so that they intersect and have the children place all of the blocks again on these two lines.



HOW CAN WE DESCRIBE THE LOCATION OF THE SET OF ALL THE BLOCKS? (The set of all the blocks is on either the red line or on the blue line.)

Explain that we can call this set the union of the red and blue lines, since all the points in each of the lines is included in the set. You may wish to review the set concepts (union and intersection) from Unit 8.

Activity B

For this activity you will need red blocks, blue blocks and blocks that are both red and blue. Prepare the red-and-blue blocks by pasting red paper on one face of a blue block or vice versa. Arrange two pieces of yarn (red and blue) on the floor to form two intersecting closed curves.

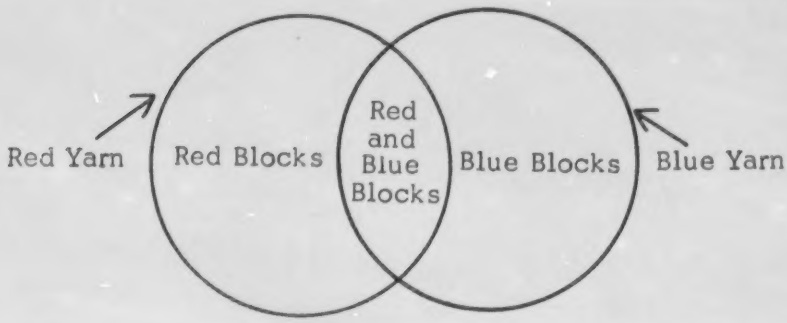
Now give the following directions, one at a time:

PLACE THE RED BLOCKS INSIDE THE RED CURVE, BUT OUTSIDE THE BLUE CURVE.

PLACE THE BLUE BLOCKS INSIDE THE BLUE CURVE, BUT OUTSIDE OF THE RED ONE.

In giving the next instruction, be alert for children who wish to place blocks on the two points where the curves intersect, rather than in the intersection region.

PLACE THE BLOCKS COLORED BOTH RED AND BLUE IN THE REGION THAT IS THE INTERSECTION OF THE TWO REGIONS INSIDE THE TWO CLOSED CURVES.



Call out the descriptions given below and have the children take turns removing the blocks from the regions that fit each description, until all the blocks have been removed. Have each child take away at least one block. Some of the descriptions will probably need to be repeated before all of the blocks can be removed. For a two-part description, give the first part and let a child find that location. Then go on to give the second part of the description -- the part that further limits the location.

TAKE A BLOCK FROM THE REGION THAT IS INSIDE THE BLUE CURVE -- AND OUTSIDE THE RED CURVE. (A blue block.)

TAKE A BLOCK IN THE SET INSIDE THE RED CURVE -- AND OUTSIDE THE BLUE CURVE. (A red block.)

TAKE A BLOCK FROM THE INTERSECTION OF THE REGIONS INSIDE BOTH CURVES. (A red-and-blue block.)

TAKE A BLOCK FROM INSIDE THE RED CURVE -- AND FROM INSIDE THE BLUE CURVE. (A red-and-blue block.)

TAKE A BLOCK FROM THE REGION INSIDE THE RED CURVE. (A red block or a red-and-blue block.)

TAKE A BLOCK FROM THE REGION THAT IS THE UNION OF THE REGIONS INSIDE BOTH CURVES. (Any block.)

TAKE A BLOCK FROM A REGION THAT IS INSIDE EITHER THE BLUE OR THE RED CURVE. (Any block.)

TAKE A BLOCK IN THE SET THAT IS OUTSIDE THE RED CURVE -- AND OUTSIDE THE BLUE CURVE. (No blocks.)

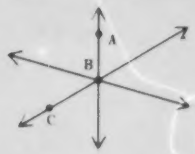
TAKE A BLOCK IN THE SET THAT IS OUTSIDE THE UNION OF THE REGIONS OF BOTH CURVES. (No blocks.)

Have the children do Worksheets 26, 27 and 28.

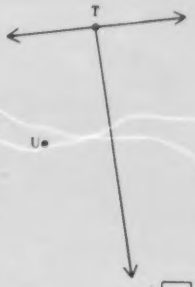
Worksheet 26
Unit 10

Name_____

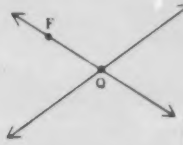
In each diagram several points are marked. Only one point is on the intersection of the lines in each diagram. Write the name of that point in the box.



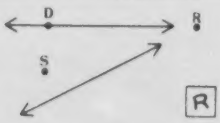
B



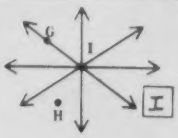
T



Q



R



I

Worksheet 27
Unit 10

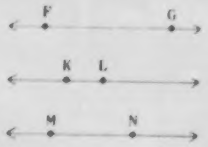
Name_____

In each box, write the name of the point that is on the intersection of the lines.

R

C

V



Worksheet 28
Unit 10

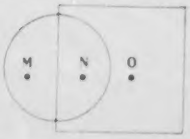
Name_____

Color the square region red.

Color the circular region blue.

Write on the line the name of any point that is in both regions.

E



N

B

Lesson 10: INTERSECTION POINTS ON A GRID

In this lesson the children work with lines that form a grid. They name the lines on the grid so that they can locate and describe different intersections, and thus practice locating points at the intersection of the grid lines.

This is the introduction to a mathematics concept that will be used a great deal in MINNEMAST units -- a coordinate grid. In order to provide an easy transition to future work, be careful to name locations according to the specific directions given in the procedure.

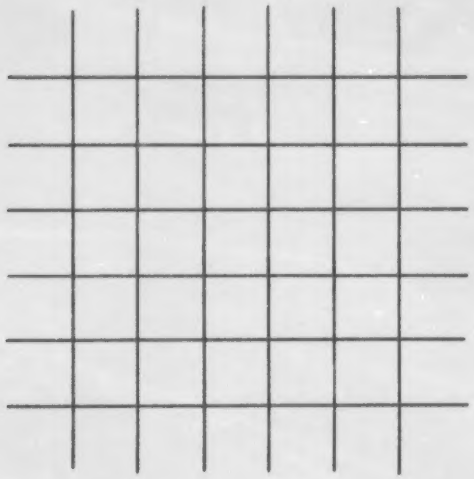
MATERIALS

- 12 lengths of yarn, each 10 feet long (all of the same color)
- masking tape
- geometric shapes or property blocks
- 12 cards labeled 1 - 6, A - F
- Worksheets 29 and 30

PROCEDURE

Activity A

This activity requires the use of a grid that has six parallel vertical lines and six parallel horizontal lines:



You can make this grid by stretching the twelve lengths of yarn on the floor, about one and one-half feet apart, and then taping the ends in place, or you can use masking tape lines. If you lack floor space, you could use a grid drawn on the chalkboard, but you would have to change the procedure somewhat. The procedure here is written for a floor grid.

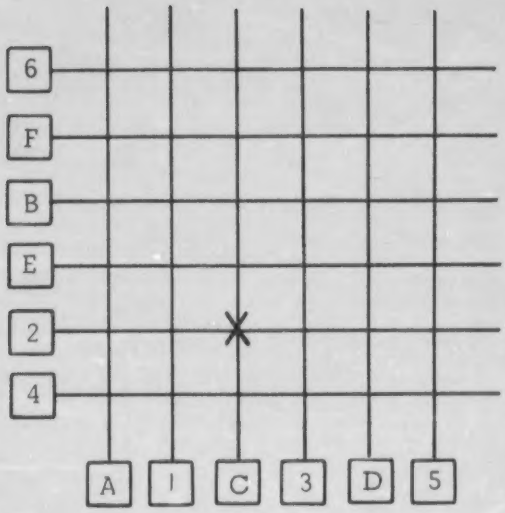
Have the labeled cards handy and ask the children to gather around the grid. Discuss with them which part of the grid they think is the top, which the bottom, which the right, etc. Elicit the idea that what is the top to one person may be the bottom to another, depending on where they are standing. Ask a child (say, Mary) to stand on any one of the intersections and pretend she is a point.

HOW CAN WE DESCRIBE THE POINT WHERE MARY IS STANDING?

Let the children try any of their suggestions. They should have the feeling that words such as top, bottom, left and right are inadequate descriptions of the location. Hopefully, some child will suggest naming the lines. If no child does, suggest it yourself, and show the children the labeled cards. You may wish to refer to the numbers and letters as "helpers."

Have the children (except Mary) all move to one side of the grid. Specify this side as the bottom. Then shuffle the cards. Ask the children to take the cards and place them along the grid at the bottom and at the left. Have them placed randomly. (Tape them to the floor, if you wish.)

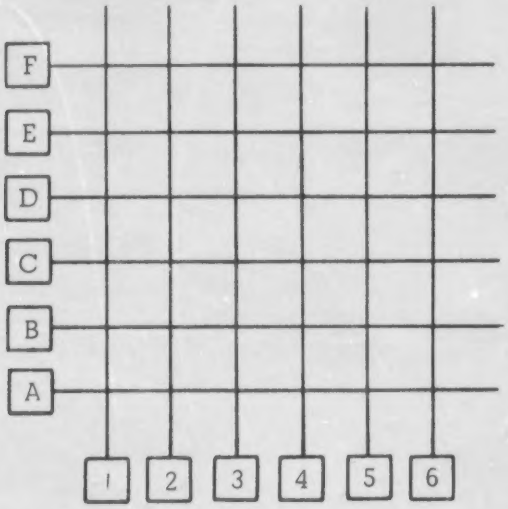
After the lines are labeled, you may wish to let some of the children move to other sides of the grid so they can see better. Mary, however, should still be standing on the intersection she chose. Her place on our example is indicated by an X. With labels randomly placed, your grid may now look something like the one on the next page.



Ask:

NOW CAN ANYONE TELL ME WHERE MARY IS STANDING?
(Yes, on the intersection of lines C and 2.)

Ask another child to stand on a different intersection and pretend he is a point. Ask what his location is. Do this a few more times and then explain to the children that mathematicians like to label lines in some kind of order. Allow the children to help you move the number cards so that your grid looks like this:



Again, let a student (say, Jim) stand on an intersection.

WHO CAN TELL ME WHERE JIM IS STANDING? (On the intersection of lines 4 and D.)

Activity B

Use the same floor grid as in Activity A. In this activity the children will put geometric shapes at specified intersections. Whenever you name an intersection, be certain to describe the location by saying first the name of the vertical line and then the name of the horizontal line (in this case, numbers before letters). This is important because later on the children will learn to name a point on a grid by using a pair of numerals, and the order of the numerals will tell which line is vertical and which is horizontal. We want to establish the habit of using the correct order from the very beginning.

Ask a child to put a triangular object at the intersection of lines 3 and C. Begin by giving just the first location description, line 3. Let him locate line 3, and then give him the second location description, line C. You may wish to allow him to trace along the lines with his fingers until he locates the intersection. Continue this process, giving one direction at a time, then conclude each location description by giving the two locations together: "The triangle is at the intersection of lines 3 and C."

Have another child put a circular object at the intersection of 2 and E. Continue until the children have no difficulty locating the points you name. Then have one child place a geometric shape wherever he chooses and have another child describe the location. Repeat this as often as necessary.

Activity C

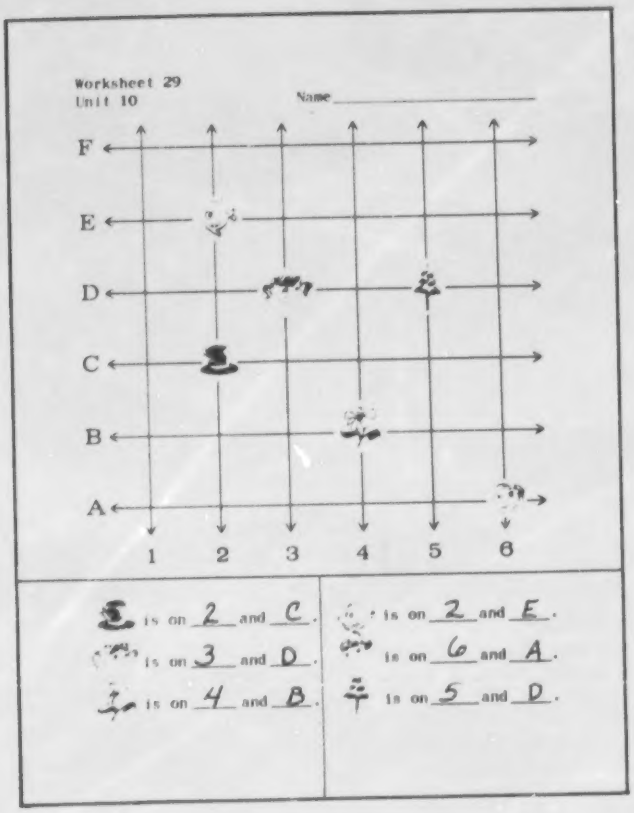
Have the children turn to Worksheet 29. Ask them to find the picture of the hat on the grid. Then ask them to describe its location.

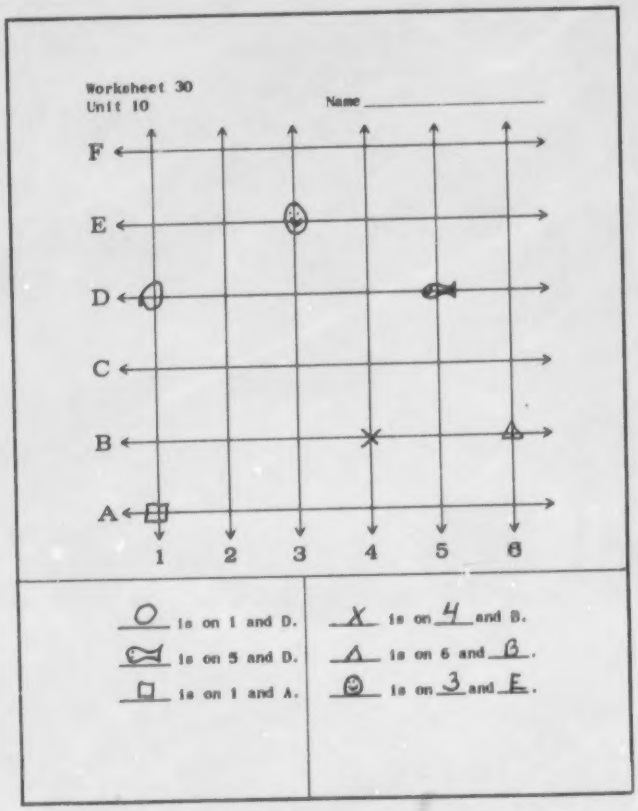
ON WHAT NUMBERED LINE IS THE HAT? (2.)

ON WHAT LETTERED LINE IS THE HAT? (C.)

YES, THE HAT IS ON THE INTERSECTION OF LINE 2 AND LINE C.

Help them fill in the first set of blanks. Have them locate the other pictures, one by one. Use the step-by-step procedure above for each, only as long as the children need the help.





On Worksheet 30, the children will draw their own pictures according to your directions and then fill in the location descriptions. Read the following instructions to them, one by one, and pause to give them time to do each.

1. DRAW A CIRCLE ON THE INTERSECTION OF LINE 1 AND LINE D.

2. DRAW A FISH ON THE INTERSECTION OF LINE 5 AND LINE D.

3. DRAW A SQUARE ON THE INTERSECTION OF LINE 1 AND LINE A.

4. DRAW AN X ON THE INTERSECTION OF LINE 4 AND LINE B.

5. DRAW A TRIANGLE ON THE INTERSECTION OF LINE 6 AND LINE B.

6. DRAW A FACE ON THE INTERSECTION OF LINE 3 AND LINE E.

To fill in the bottom of the worksheet, the children should look at each of the shapes they drew, and copy the shape that corresponds with the location description.

Lesson 11: LOCATIONS BETWEEN PARALLEL LINES

In this lesson the children locate intersecting regions between lines in much the same manner as we locate regions on road maps. First they locate a region between two lines. Then they locate another region between two more lines that cross the first two. Finally they locate the intersection of the two regions. This lesson prepares the children for work with maps in Lessons 12 and 13.

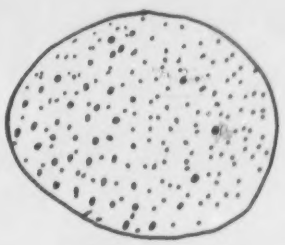
MATERIALS

- 6 ten-foot pieces of yarn of different colors (red, blue, green, yellow, black and white)
- property blocks
- red, yellow and blue crayons for each child
- overhead projector, transparencies of worksheets (optional)
- Worksheets 31, 32 (2 copies) and 33

PROCEDURE

Activity A

Draw a closed curve, about twenty inches in diameter and resembling a circle, on your chalkboard. Draw this closed curve at a height the children can easily reach. Remind the children that this is called a closed curve. Let one or two of the children come up to the chalkboard and draw points (dots) inside the closed curve — on the region defined by the closed curve. Let different children come up to the chalkboard and draw as many points on this region as they can.

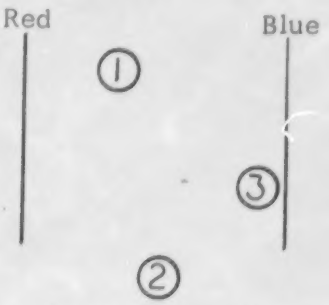


Lead the children to the conclusion that a region contains or is made up of a set of points.

Draw two parallel lines on your chalkboard and repeat the above activity, this time drawing as many points between the lines as you feel are necessary in order to help the children grasp the idea that regions of a plane are made up of sets of points. This is only meant to be an introduction to this concept. Do no over-emphasize or dwell very long on this idea.

Activity B

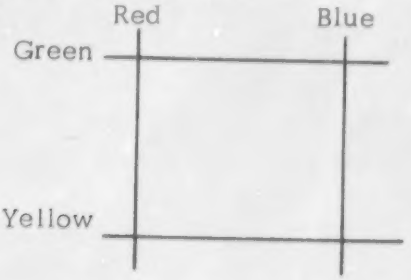
About three feet apart, lay out the lengths of red and blue yarn so that they are parallel to each other.



Ask child 1 to stand between these line segments. Ask child 2 to stand between the lines they can imagine as extending beyond the ends of the segments represented by the yarn. Ask a third child to stand anywhere else between the two lines.

HOW CAN WE DESCRIBE THE LOCATION OF ALL CHILDREN IN THIS SET? (On points in the region between the red line and the blue line.)

Have the three children return to their seats. Now lay green and yellow yarn across the red and blue yarn, three feet apart and parallel to each other. Your resulting arrangement of yarn should look like a tic-tac-toe diagram.



Have three different children stand between the green and the yellow lines. If no one is in the 4-sided figure (center of the diagram) formed by the intersecting pairs of lines, ask a child to stand there.

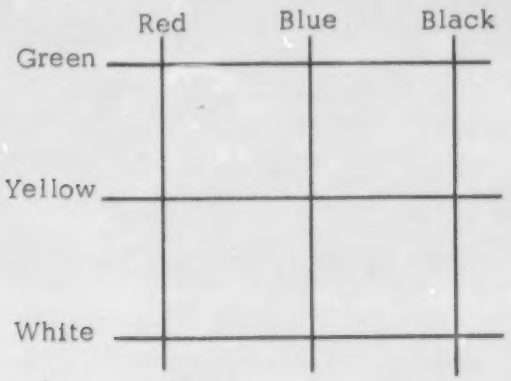
HOW CAN WE DESCRIBE THE LOCATION OF THIS SECOND SET OF CHILDREN? (Between the green and the yellow lines.)

WHAT ABOUT THE CHILD STANDING IN THE CENTRAL REGION? HOW CAN WE DESCRIBE HIS LOCATION?

Lead the children to see that he is located both in the region between the red and blue lines, and in the region between the green and yellow lines. He is in the intersection of the two regions. The child in the central region is a member of the set of children located between the red and blue lines and is also a member of the set of children located between the green and yellow lines. He belongs to the intersection of the two sets of children.

Activity C

Have the children sit down around your floor diagram. Add two more pieces of yarn (say black and white) to complete the diagram shown below:



Tell the children that you are going to give them location descriptions and that they are to take turns putting property blocks in the locations you describe. The first four

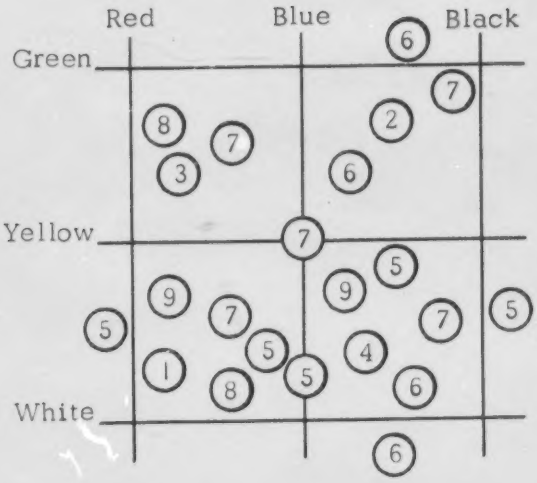
descriptions you will give apply to only one location each. Beginning with the fifth, several locations may fit a description. Some descriptions apply to locations anywhere between two parallel lines. For these, encourage the children to place blocks in the appropriate open-ended regions as well as in the bounded regions. Some descriptions apply to regions between lines that are not adjacent. Have the children place blocks in each of the locations that can fit the description.

Read one part of each description at a time. After the child has located one region, give him the second region that further limits the location. Ask the children to locate the following regions and place blocks in them.

Region:

1. Between the red and blue lines and also between the white and yellow lines.
2. Between the blue and black lines and also between the yellow and green lines.
3. Between the red and blue lines and also between the yellow and green lines.
4. Between the blue and black lines and also between the white and yellow lines.
5. Between the white and yellow lines.
6. Between the blue and black lines.
7. Between the red and black lines and also between the white and green lines.
8. Between the red and blue lines and also between the white and green lines.
9. Between the red and black lines and also between the white and yellow lines.

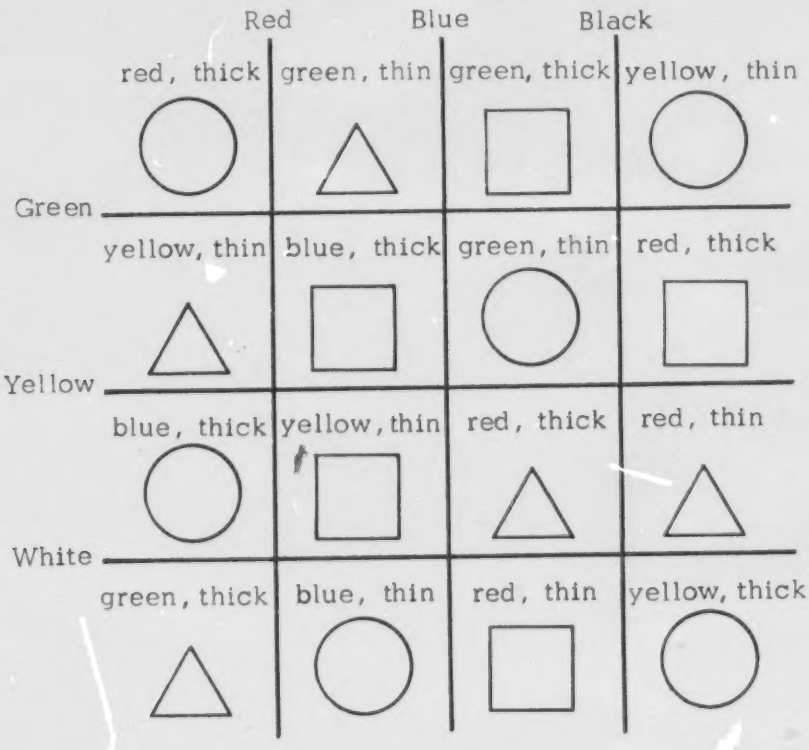
Numbered circles in the figure on the next page show (roughly) locations that will satisfy each description.



Activity D

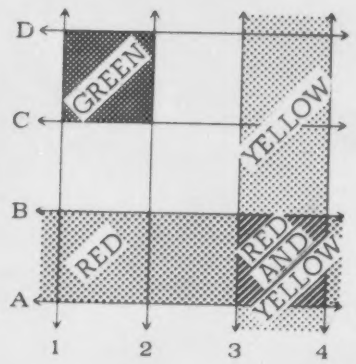
Pick up the property blocks and rearrange sixteen of them so that a block of a different kind is in each of the sixteen different regions. As you describe each block by shape, size, color and thickness, ask the children to describe its location in terms of two pairs of reference lines, or only one pair of lines if it is in a region open at one side.

The following is one possible distribution of the blocks.



Worksheet 31
Unit 10

Name _____



I colored red between lines A and B.

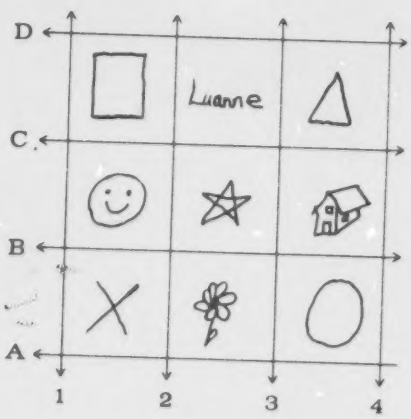
I colored yellow between lines 3 and 4.

I colored both red and yellow between lines A and B and also between lines 3 and 4.

I colored green between lines C and D and also between lines 1 and 2.

Worksheet 32
Unit 10

Name _____



My name is in the region that is between lines 2 and 3 and also between lines C and D.

Activity E

Have the children complete Worksheets 31 and 32 as a class activity. Give directions orally.

Tell the children that you are going to give some location descriptions and tell what color they should use in each. Ask them to color the whole space for each description lightly, because some locations will be colored more than once.

Give the following directions, one by one, for Worksheet 31:

1. Color red all the points in the region between lines A and B.

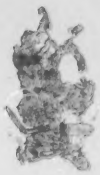
2. Find the region that is between lines 1 and 2 and also between lines C and D. Find the points that are in the intersection of the two regions. Color them green.

3. Color yellow all the points in the region between lines 3 and 4.

Now read each line below the diagram on Worksheet 31, so that the children can fill in the location descriptions.

Have the children follow these directions for completing Worksheet 32:

1. Find the region between lines 3 and 4. Find the region between



lines A and B. Draw a circle in the intersection of the two regions.

2. Find the region between lines 1 and 2. Find the region between lines C and D. Draw a square in the intersection of the two regions.

3. Find the region between lines 3 and 4. Find the region between lines C and D. Draw a triangle in the intersection of the two regions.

4. Find the region between lines 2 and 3. Find the region between lines B and C. Draw a star in the intersection of the two regions.

5. Find the region between lines 1 and 2. Find the region between lines A and B. Draw an X in the intersection of the two regions.

6. Find the region between lines 3 and 4. Find the region between lines B and C. Draw a house in the intersection of the two regions.

7. Find the region between lines 1 and 2. Find the region between lines B and C. Draw Smiley's face in the intersection of the two regions.

8. Find the region between lines 2 and 3. Find the region between lines A and B. Draw a flower in the intersection of the two regions.

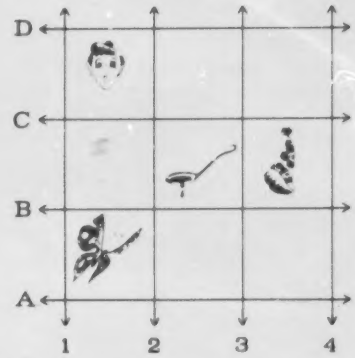
9. There should be just one square you haven't drawn any figure in. Find it, and write your name there. Write your name's location in the blanks on your worksheet.

Activities like those on Worksheet 31 can be adapted for use with the overhead projector. Ask the children to describe locations of objects as you place them on a labeled grid drawn on a transparency.

Two copies of Worksheet 32 are provided for each child. You may make up new instructions, asking the children to draw other pictures in the regions whose locations you describe. You may also use these duplicates for more intersection point exercises, like those on Worksheet 30 in the previous lesson.

Worksheet 33
Unit 10

Name _____



The is between 3 and 4 and also B and C.

The is between 1 and 2 and also C and D.

The is between 1 and 2 and also A and B.

The is between 2 and 3 and also B and C.

These regions are called intersections.

Help the children complete Worksheet 33. You may also wish to use the overhead projector for this worksheet. Descriptions of locations given in this manner may be more difficult for the children, and they may require more of your help.

Lesson 12: "WHERE HAS SALLY BEEN?"

On Worksheet 34, the children trace the path of a little girl by following location descriptions from the story, "Where Has Sally Been?" Then they describe in as many ways as they can the locations where she paused.

MATERIALS

- Worksheet 34
- Sally cutouts (use those on page 89)
- transparency of Worksheet 34 (optional)
- overhead projector (optional)

PROCEDURE

If you have an overhead projector, make a transparency of Worksheet 34. If not, copy the map on the chalkboard and trace Sally's path there. Cut out the appropriate figure of Sally and mount on tagboard for easy handling. Make a loop of tape and fasten it, sticky side out, to the back of the Sally figure.

The places where Sally pauses are numbered in the story. Put the Sally figure at each of these locations. You may wish to allow the children to help with this.

Sometimes the description of a place is vague enough so that several positions on the map are described by it. More than one path can be drawn to connect successive locations where Sally has paused. You can use this fact to indicate to the children that some kinds of descriptions may be more useful than others.

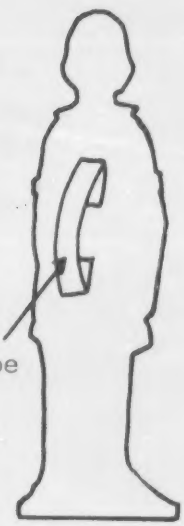
"Where Has Sally Been?" is a problem in story form, not a story. It must be read slowly, with appropriate pauses for tracing Sally's path. You must be prepared to stop, repeat descriptions and state them again in different words to help children who are having difficulty.

After you have finished the story, have the children turn to Worksheet 34. Read the story again while the children write the appropriate numerals at the places where Sally pauses. Then they should trace Sally's path in pencil on their worksheets.

SALLY CUTOUTS

For use with the overhead projector

For use with the chalkboard map



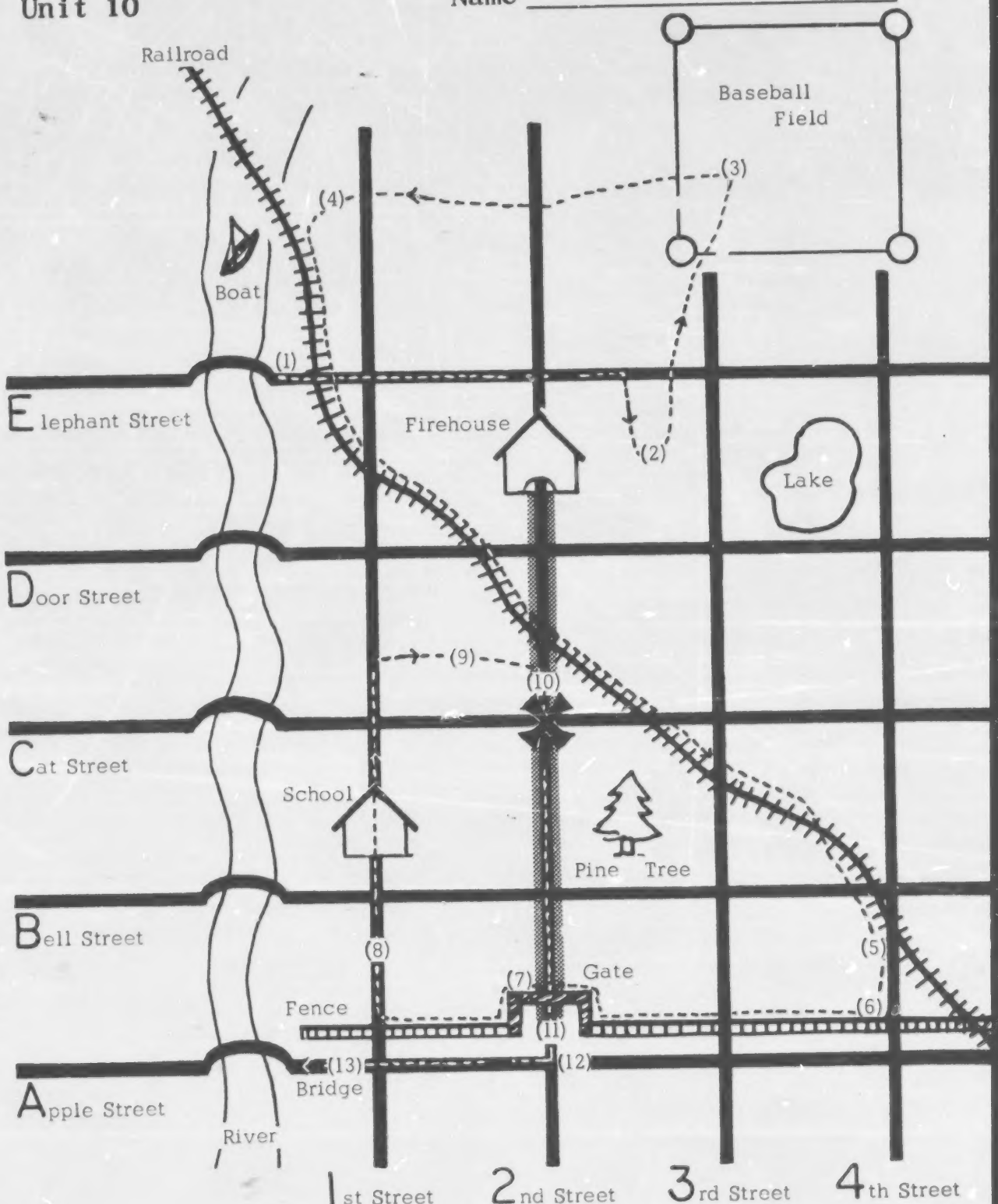
Sticky side of tape

Reverse side of Sally figure

An extra copy of the cutouts is provided on page 89.

Worksheet 34 (Answers)
Unit 10

Name _____



WHERE HAS SALLY BEEN?

Sally and her father were driving on the highway on a warm Saturday in spring. They were going to visit her father's old friend who had a farm where he grew vegetables just outside the city. On the way they drove past a strange-looking town that Sally had never seen before. There was a railroad track running through it, and a river, and there were many streets laid out in neat squares across the fields. There was a lake, and even a baseball field. There was also a large red firehouse and a little white school. In the center of one street there was a large gate that led through a fence. The fence cut across some streets and empty lots, but there were no houses at all! It was, indeed, a very strange town.

"Where are the houses?" Sally asked.

"This is a new town," her father said. "They haven't finished building it yet. They have finished the streets, but not the houses. When they do build the houses you will see that the school and the firehouse will be located right in the middle of the town."

"I'd like to explore this town," Sally said. "I've never been in a town that didn't have any houses."

"All right, I'll let you out right here, at Elephant Street Bridge. You can explore all you want to and I'll pick you up in an hour at the Apple Street Bridge. Then you can tell me where you've been and what you've seen."

Sally got out of the car and started exploring. Here is where she started: (1) She walked along Elephant Street. Soon she crossed the railroad tracks. She continued along Elephant Street

in the direction from the bridge to the track. Then she wandered off the street. She was in an empty lot between Elephant Street and Door Street and between 2nd Street and 3rd Street. (2)

Then Sally thought she saw something interesting in another direction. She crossed Elephant Street to find out what it was. She crossed to the inside of a large diamond-shaped closed curve that was located on the opposite side of Elephant Street from the firehouse. She stood for a moment inside the closed curve. (3) "Why, it's a baseball field!" she exclaimed. "It looks so funny out here all by itself."

She walked out of the closed curve and toward the river. She crossed 2nd Street and then 1st Street. (4) Now she could see the railroad track, and she followed it, walking on the ties. The track crossed Elephant Street. So did Sally. The track crossed 1st Street. So did Sally. Sally walked on the track, until she crossed 3rd Street and then Bell Street. (5)

Just after the railroad track crossed 4th Street, it was intersected by a fence. Sally suddenly remembered that she was never supposed to walk on a railroad track, so she got off it and climbed on the fence. (6) She began walking along the top of the fence, carefully balancing herself. She walked in the direction from the railroad track to the gate. She walked right over the top of the gate, (7) and continued beyond it in the same direction.

Where the fence intersected 1st Street, Sally hopped off. (8) She went along 1st Street in the direction from the fence to the school. She went past the school.

After crossing Cat Street, Sally left 1st Street. She stood in an empty lot between 1st Street and 2nd Street. (9) She walked over to 2nd Street, and stood for a minute between the firehouse and the gate, looking around. (10)

She saw a lake past the railroad track, and was about to go over to it. But then, she heard the horn of her father's car, blasting away impatiently.

Sally ran along 2nd Street toward the gate. She ran through the gate. (11) Where 2nd Street crossed Apple Street, she turned (12), and ran toward the bridge. There was her father waiting for her. (13)

"Oh Dad, I saw the prettiest little lake, but it would have taken me too long to get there. I was standing on 2nd Street, between the firehouse and the gate." (Color this part of 2nd Street.)

Her father asked, "On what part of the segment of 2nd Street were you, Sally?"

"Right where Cat Street crossed 2nd Street." (Put an X there.)

"What path would you have followed if you had gone to the lake?" her dad asked. Sally couldn't describe the path she would have followed.

CAN YOU DRAW A PATH TO GET SALLY FROM THE INTERSECTION OF 2ND STREET AND CAT STREET TO THE LAKE?

CAN YOU DESCRIBE SOME OF THE PLACES SALLY WOULD HAVE GONE PAST IF SHE HAD FOLLOWED THIS PATH?

"Where did you go?" Sally's father asked. "You were exploring for quite a long time." But Sally had no map -- she couldn't remember. Perhaps you can help her out.

Have the children turn to Worksheet 34. They should locate Sally's stops on their maps and mark them with the numbers given in the story.

WHO CAN TELL ME WHERE SALLY WENT FIRST?

Refer to the story, reading location descriptions when necessary, until Sally's whole walk has been recorded. Have the children give descriptions of her locations at various points along the path as they trace it. Ask for direction descriptions frequently. Try to elicit more than one location description for each position, whenever possible.

You may want to project the map for review. Put Sally at different points and have the children describe her locations or let an individual child describe a location while another places the figure of Sally there.

Lesson 13: A SIMPLE MAP OF THE CLASSROOM

In this lesson each child locates his desk on a simple map of the classroom. To facilitate orientation, the children find their desks while the map is on the floor, since no reference objects such as windows, bookcases, or the door are provided.

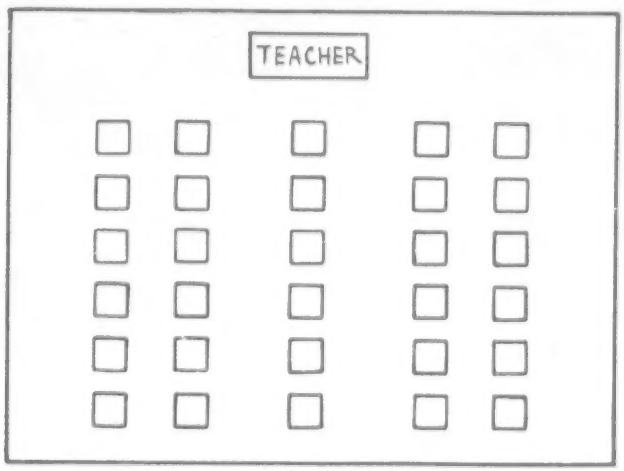
Optional activities include having the children make maps of a room at home, and one of the playground.

MATERIALS

- felt-tip marking pen
- wrapping paper, 4 feet square
- masking tape
- name card for each child
- property blocks (optional)

PREPARATION

With a felt-tip marker, make a large map of the classroom on the wrapping paper. Represent the location of the walls of the room, the children's desks and your own desk as accurately as you can. You should give a view from the back of the room with your desk at the top of the page, the first row of children's desks just below it, etc. Do not draw any other furniture, or additional clues such as blackboards, doors or windows. Make certain to draw your diagram so that the desks appear in their proper locations, even if the desks are not arranged in a rectangular array.



PROCEDURE

Give each child a small piece of cardboard on which to print his name. Ask the children to make their names large enough to be read from a distance. (You may wish to print these cards yourself.) Put your name on a card, too. Put the map of the classroom on the floor in such a way that the front of the room on the map is toward the front of the room itself. Have the children take turns standing at the bottom of the map and looking down at it, so that they see the last row of desks at the bottom of the map.

Explain that this is a map representing the arrangement of desks in the classroom. The desks are represented in the way that a street map represents the position of blocks in a city. We have not drawn pictures showing what the desks look like. Outlines show where the objects are, relative to one another.

Have the children find your desk on the map. Tape your name card on it. Then ask the children to try to locate their own desks on the map, and put their name cards in place. A few children at corners or in the front row may have no difficulty, but those who sit in seats somewhere around the center of the room may find they cannot tell exactly which rectangles represent their desks. They may try counting rows or locate their own desks in relation to their neighbors. When children count columns or rows, have them stand at the front of the room. Encourage them to count from left to right, and from front to back.

After the map has been completed, call the children's attention to the other objects in the room which haven't been shown on the map. (These might include bookshelves, display tables, the science table, sinks, flagstand, easels, chairs, doors and windows.) Have several children show where they think the objects belong on the map. Draw the items in, and label them.

After the map is completed on the floor, put it up on the bulletin board so that the children can get used to its new orientation.

OPTIONAL ACTIVITIES

1. Ask each child to make a map showing the locations of furniture in a room at home. Emphasize that this map is not to be a picture showing what the furniture looks like. It is to show only where the pieces of furniture are relative to each other and to the walls of the room. An easy way to make the map is to arrange blocks or other small, easily-traced objects on a piece of paper to represent the furniture. When the arrangement is satisfactory, trace around the edges of the blocks. The traced outlines might then be labeled "my bed," "my brother's bed," "chair," and so on. Encourage the children to involve older children or parents in this activity.

2. Have the children work together on a map of the playground that shows the positions of such things as play equipment, large trees and shrubs, fences, the school building and parking lots. They could draw on wrapping paper or set blocks on a table and label them. The map could consist of simple outlines of geometric shapes, or could use points to represent objects. An elaborate project might include pipe-cleaner swings and trees made of crumpled green tissue paper. The children might start this with a representation of a small area and then expand it to include adjacent areas.

Lesson 14: A MAP OF THE NEIGHBORHOOD

This lesson is both a review and an extension of this unit's activities. You and the children should make a map of the neighborhood, either a small one showing only the school and objects in its immediate vicinity, or a larger map showing what the children see on their different routes to school. Because neighborhood complexities and children's abilities vary, the design of the lesson is left up to you. There are many ways to carry out the project. We give one example below. The lesson will take several class sessions.

MATERIALS

- wrapping paper, 3 x 4 feet
- yarn
- construction paper
- scissors

PROCEDURE

Activity A

Begin with a discussion about what the children see on the way to school. Have the children locate the grocery store, mailbox, park, etc., relative to the school. The children will be alerted by the initial discussion to observe more closely along their route for the following day. Encourage them to think about "intersection," "between," and "in the direction of" as they gather the information for the map.

Lay the piece of wrapping paper on the floor. Place a construction paper cutout of the school building on it, and then use lengths of yarn to lay out the streets. Construction paper cutouts of landmarks such as buildings, mailboxes, should be placed according to the children's suggestions. Do not paste these down until the children have agreed upon the locations.

If possible, take the class on an excursion to check on the locations you will be showing on the map.

If mapping the neighborhood is impossible for some reason, have the class map the layout of the school building. Don't forget the basement, if there is one. What to do if there is more than one floor presents a challenging problem for the children.

Activity B

When the map is finished, have children take turns showing and describing the routes they follow on their way to and from school.

Post maps of your city and state for the children to become familiar with. Conduct such discussion as is necessary for the children to see that these maps are made and read according to the same principles used in the map of your neighborhood.

When the children have completed the unit work, tell them they may tear out the last page of their Student Manuals to take home. This page shows the various places a girl visited on her way from home to school. The children may enjoy giving the location descriptions of some of these places to show what they have learned.

Review Note

The kinds of location descriptions studied in this unit are:

(1.) On a line between two reference objects.

(2.) On a line beyond one of the objects in a certain direction.

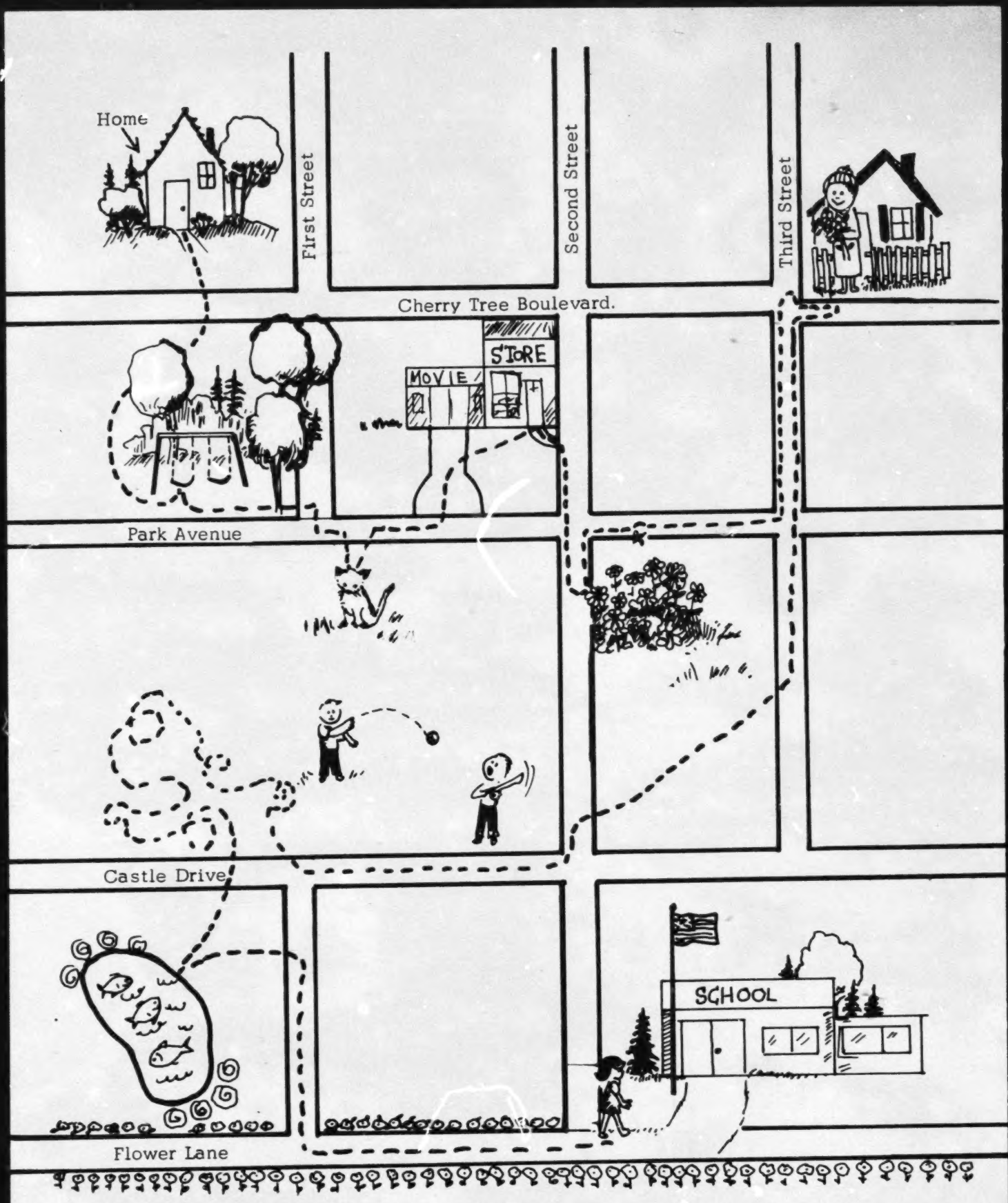
(3.) Inside, outside, or on a closed curve.

(4.) Between two parallel lines.

(5.) In the region where two strips between pairs of parallel lines intersect.

(6.) On the intersection point of two lines.

All of the places where Sally has been can be described in several of these ways.



Take this page home and see how well you can describe some of the locations the girl in the picture visited on her way to school.

SALLY CUTOUTS

For use with the
overhead projector

For use with the
chalkboard map

Sticky side of tape

Reverse side of Sally figure